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Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

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Electrical World

Published by McGraw-Hill Publishing Company, Inc.
W. H. ONKEN, JR.
Editor

VOLUME 91 — *New York, Saturday, February 25, 1928* — NUMBER 8

Now for Defense and Vindication

TO THE Federal Trade Commission has been given the task of investigating public utility and closely allied corporations. Senator Walsh's proposal for a senatorial inquiry has been denied and the industry spared the invective and calumny which the three-day debate in the Senate indicated would surely be heaped upon it had the original measure passed. Factual rather than sensational information ought, therefore, to be in order, and while the trade commission will be under pressure, the case against the utilities will, we have a right to expect, be conducted along judicial lines and not along the lines of prosecution. This outcome of the matter should be an occasion for congratulation but not for rejoicing, for the industry will be subjected to searching inquiry, and the desire of the commission to bring out all the facts will inevitably elicit much irrelevant, biased and misleading testimony which will be read by many who will not read that on the other side.

It is regrettable that passion instead of reason marked the debate in the Senate on the resolution and Senator George's amendment to it. Those who argued to place the investigation in the hands of the Federal Trade Commission were accused by inference of being bought by utility money; the trade commission itself was charged with incompetency and said to represent "big business" only, and as for the executives and others of the utility industries involved, they were all lobbyists. For three days the Senate debated without bringing out one constructive thought or any good reason, for that matter, why there should be an investigation at all. Senator Walsh presumably held back information, hoping at a proper time to startle the country. Others cluttered up the record with statistics on the comparative rates of municipal and privately owned generating stations, as though rates had anything to do with the question or even came within the purview and constitutional scope of the national government.

Obviously, from a utility angle the situation was anything but reassuring, and the Senate did well, in vindication of itself as well as in justice to the utilities, to turn the matter over to the Federal Trade Commission. There the complete story may be told—to a gathering, not partial to be sure, but at any rate to one not prejudiced—and the record can speak for itself. The utility companies of this country have made wonderful social and economic contributions—too great in fact to be ignored or lightly set aside. They are entitled to a fair hearing, and the submission of their case to the Federal Trade Commission would indicate that the Senate of the United States means that the utilities shall have it. When the case will end and what the final judgment is to be will be revealed in due season. The verdict should be one of exculpation and reassurance. No other outcome is thinkable if the case of the public utility companies is properly presented.

* * * *

High Lights of the A.I.E.E. Winter Convention

GREATER interest even than usual was attracted to the winter convention of the American Institute of Electrical Engineers last week by the epochal joint radiotelephonic meeting with the British Institution and the presentation of both the Edison and the John Fritz medals. But even without these events the meeting would have ranked high among technical gatherings of recent years, and the Institute and the convention committee are to be congratulated upon it. No convention in the electrical industry has more value than this both to engineers who desire to be informed of current principles and practices and, in the case of some of the sessions, to men outside the fraternity, who can profit by the knowledge and force with which the engineers discuss many economic problems.

The meeting on interconnection was outstanding. The papers and discussions were good and many sound principles were stated, including words of caution about embarking upon schemes of interconnection without first making careful economic studies and hints that many interconnections cost more than they saved. Interconnection is a guarantee of service and is an insurance reserve which meets, for a minimum cost, the necessity for giving better electric service. But it costs money to improve service standards, and loose talking can be corrected if this fact is better understood. In the realm of lightning a good operating paper was presented by Philip Sporn, and Doctor Norinder gave hints of further technical progress. The instrument developed by Doctor Norinder apparently has many advantages for field surveys and, if used in this country, should bring out facts that will enable engineers to deal with insulation in tangible terms. Aside from some ideas of voltage magnitude, however, lightning still baffles the industry. Machinery and communication papers showed a steady advance in the art. The lecture of Doctor Swann and several scientific papers proved valuable and interesting. One of the encouraging trends was to find that engineers are attempting to discard the infinitesimal or mathematical method of analysis in favor of a basic work-and-energy approach to their problems. This means more complication, but the method deals with realities and not with assumptions made to satisfy the Maxwellian equations.

Two Coveted Medals Are Worthily Awarded

BESTOWAL of the John Fritz medal upon General J. J. Carty of the American Telephone & Telegraph Company and of the Edison medal upon Dr. W. D. Coolidge of the research laboratory of the General Electric Company has met the hearty indorsement and approval of engineers and scientists everywhere. Few men have worked harder or longer in the service of electrical science than Carty and Coolidge, and although they labored in different fields, the first in telephony and the second in electrical research, both were worthy recipients of the great honor conferred on them.

As an original research worker and inventor Doctor Coolidge stands in the front rank of scientific men. While he has done magnificent work with the medical X-ray and high-voltage vacuum tube, he is probably best known to the world and to American electrical engineers in particular for his work on incandescent electric lamps with ductile-tungsten filaments. Nor is the Edison medal the only honor bestowed on him. Others besides the American Institute of Electrical Engineers have recognized his work. The Rumford medal was awarded him in 1914, and in 1926 he received the Howard N. Potts medal, and the Louis Edward Levy gold medal. Last year the Royal Society of London honored him with the Hughes medal and the American College of Radiology gave him a gold medal. Thus he is not a prophet without honor in his own country and in others.

Of the two medalists General Carty is the better known. As the organizer and head for many years of the great technical staff of the still greater American Telephone & Telegraph Company, General Carty has been responsible for the superior excellence of American telephone service. He is primarily an organizer, having inherited some of the stupendous ability of the late T. N. Vail, than whom telephony had no keener or greater leader. Honored by his own as well as by foreign governments, given doctor's degrees by nine colleges and universities, and possessing three medals in addition to that bearing the name of John Fritz, General Carty's standing in the world is firmly established. His work with the American Expeditionary Forces during the World War was of extraordinary value in organizing and maintaining the communication service that was such a vital factor in America's contribution to victory.

* * * *

Analysis of Disturbances Suggests Remedy

ELIMINATION of transmission-line interruptions comes nearer to reality every time that an operating company makes a thorough study of its disturbances, analyzes the causes and endeavors through exchange of experience to prevent their recurrence or minimize their effects. A few such reports have been made public in the last year or so, notably those by Philip Sporn of the American Gas & Electric Company and J. G. Hemstreet of the Consumers Power Company.

When more companies overcome the fear that discussing interruptions will ruin their business and develop the courage to throw their experiences into a common melting pot, the day will be hastened when interruptions will not be considered so serious a problem. Such reports will help to confirm or disprove some of the ideas which have been developed, theoretically or in the laboratory. They will also bring forth factors that might otherwise be overlooked. In this field of investigation, as in others, the majority of companies should not expect to sit back and profit from the work of a few pioneers. To those who view the situation in perspective investigations behind closed doors usually result in retarded progress.

In the most recent report by Mr. Sporn (abstracted on page 411 of this issue) it is pointed out that experience has led to: (1) An extensive program of ground-wire installation with an increase in the number of such conductors at the terminals of lines to reduce the surge impedance from the last tower to the bus; (2) increased insulation of the line conductors except within a mile or so of the terminals, where the insulation is reduced to make certain that the insulating value of the station apparatus equals or exceeds the flashover value of the adjacent line insulation; (3) avoidance of tower extensions where feasible, or at least a net reduction in the average height of spans to minimize induced charges, and (4) more attention to arcing-protection arrangements, with a view to minimizing effects of conductor vibration on the protection assembly.

Conclusions from his former report have been confirmed, namely, that necessity exists for establishing a balance between tower height, span, lightning voltage, conductor spacing, insulators per string, insulation on terminal apparatus and clearances to ground; that lines of 44 kv. and over should have a ground wire unless the ground resistance is very high; that in no case should a ground wire be dismissed without consideration; that on high towers it is necessary to provide arc-protecting devices, and that lines should be so designed and relayed as to permit prompt disconnection in case of trouble.

Imagine the progress which could be achieved if more investigations of equal thoroughness were made and reported. For such studies adequate recording apparatus and means of checking the causes of any trouble are essential.

* * * *

Unshackle the Hands of the System Operator

MANY valuable papers on technical and operating phases of interconnection have been presented by various authorities at various times and places. Probably not much new has been said on the subject in the last year. Nevertheless the symposium on energy interchange and the discussion which ensued at the winter convention of the A.I.E.E. last week deserve careful reading for several reasons. They stress the operating experiences, practices and problems, as distinguished from the technical phases, and thereby give attention to that side of the interconnection which if it be not successfully handled nullifies all plans and aspirations. They make available in one place the thoughts and experiences of more than a dozen authorities in the utility field. Better than one or two viewpoints, they enable any one to orient the relative importance of different problems.

By inference—but emphasis was needed—the fact was brought out that the most attractive paper plans for taking advantage of all species of diversity to minimize reserve capacity, stagger construction, provide emergency power and effect operating economies go for naught unless the operating man is able to cope with the various

operating contingencies, contractual limitations, legal and political handicaps which at present arise on every hand. Charles L. Edgar apparently supported this view when he said, "Load dispatching is the heart of successful interconnection." With interconnection of financially independent systems there must be a give-and-take attitude in all relations, otherwise the aggregate benefits will not approach those possible under single management. W. E. Mitchell, P. M. Downing and H. B. Gear implied as much in their remarks. Proofs of this contention have become evident wherever interconnected systems have changed their attitude from that of self-interest to that of group interest.

When A. C. Marshall expressed a hope that interconnection agreements could be developed "that would not require joint interpretation by a Philadelphia lawyer and a Schenectady engineer," he voiced a widespread need for reform in interchange contracts. To this comment might be added the unwritten opinion of many load dispatchers —that most interconnection contracts are unworkable or at least serious deterrents to the realization of possible economies. Maintenance of service reliability on interconnected systems frequently operates against obtaining maximum economies, and for this reason further obstacles in the form of complicated or ironbound contracts should not be wedged into the already difficult task of system operators.

With the variety of interconnections which have been in operation for some time, there should be available experience which, if compiled, will give the answer to some operating problems still imperfectly handled. But the solution will not be forthcoming quickly unless engineers, operating men and executives individually present their problems and then jointly and frankly discuss their possible solution.

* * * *

Voices Across the Sea

IN THE words of President Archibald Page of the Institution of Electrical Engineers at its joint meeting with the American Institute of Electrical Engineers on Feb. 16, during the winter convention of the latter, we are living in an age of "extraordinary progress." We are accustomed to this idea perhaps, but President Page could emphasize it with good reason on this occasion. Rarely has there been seen so vivid an example of the triumph of engineering skill and enterprise over the difficulties caused by our ignorance of nature's hidden secrets as was presented when at this meeting, by means of radio-telephonic communication, there were linked not only two continents, but two bodies of engineers in a joint meeting which offered freedom and easy means for mutual technical discussion.

O. B. Blackwell's lucid review of the essential elements in this latest triumph in the art of communication, made just before the transatlantic session, could not in its brief extent cover the multiplicity of examples of ingenuity and skill represented in the various special apparatus and combinations of electric circuit, any one of which could be held up for special admiration. But in such features as the use of long and of short waves to meet nature's changing conditions and the acoustic cut-out for preventing interference between the sending and receiving stations on each side of the Atlantic, and in the economies in sending energy gained by single side-band transmission for the long waves and the special focus for a receiving antenna for the short waves, his description revealed a fine example of engineering research of the highest type.

Sir Oliver Lodge, speaking from London, pointed out as an essential element in all successful long-distance radio communication "nature's bounty" to man in confining the ether waves to a comparatively shallow envelope about the earth, rather than radiating them into space. Without this circumstance it is probable that this remarkable new means of interchange across the ocean would not be possible. It is not so long since electrical engineers assembled in a somewhat similar meeting to celebrate successful telephonic communication across our continent. What will be celebrated next? It is no great stretch of imagination—it is in fact a reasonably certain bet—that very soon men will not only hear one another in joint meeting across the Atlantic but will look into one another's faces as they speak.

When joint sessions of such widely separated gatherings are extensively feasible what a wonderful power will be available for removing the misunderstandings that now result in international friction and constantly tend to cause war!

* * * *

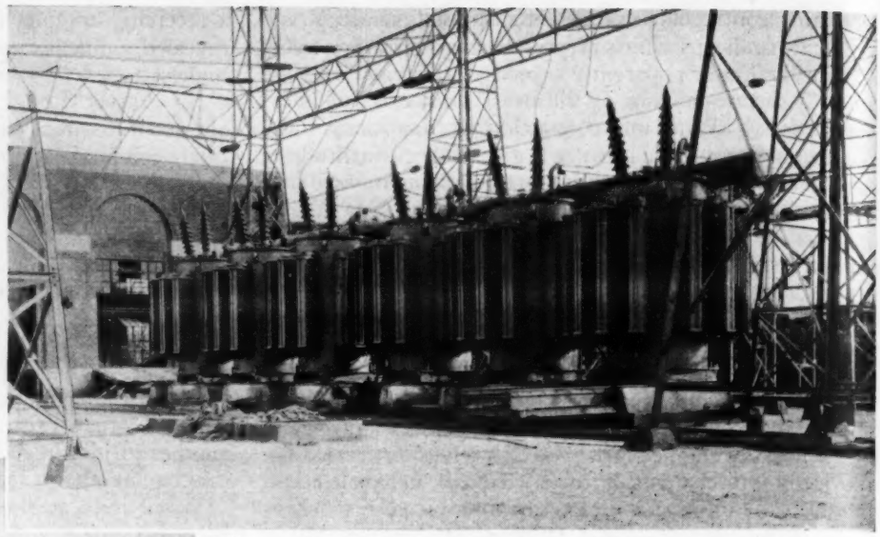
The Significance of the Harvard Advertising Award

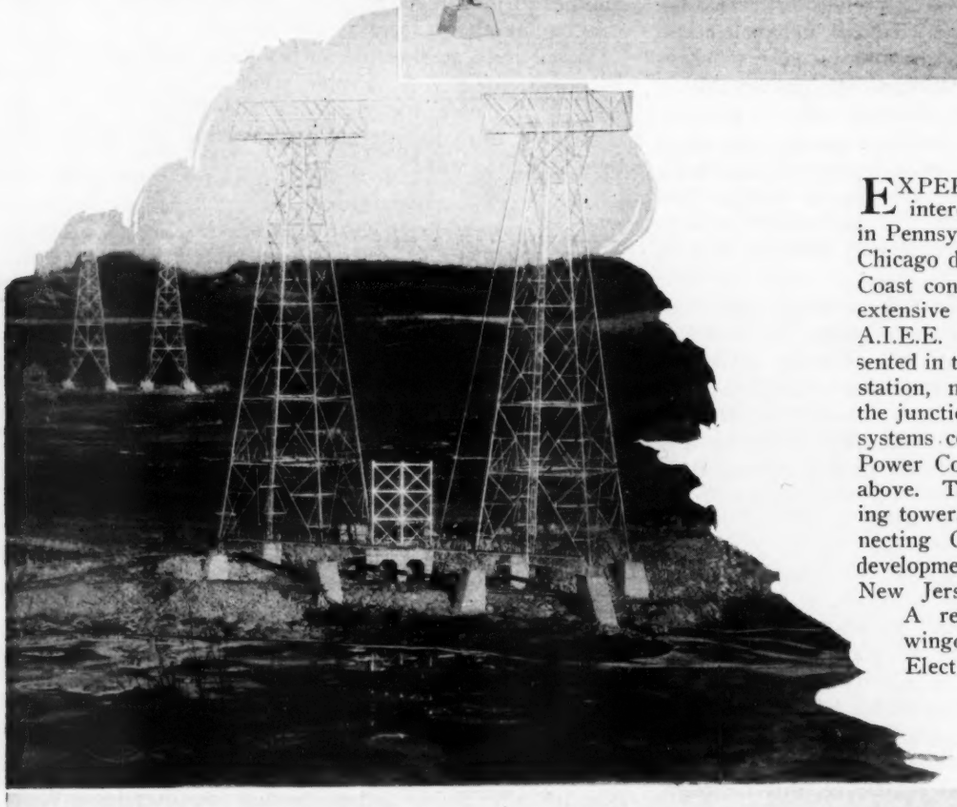
AWARD of the Harvard medal last week to James H. McGraw, publisher of the ELECTRICAL WORLD, "for distinguished contemporary service to advertising" should be of more than passing interest to electrical men. True, the electrical industry has never ranked among the larger employers of advertising, as a glance at the popular magazines of the day will attest. The romantic records of advertising have been written for the most part in terms of those commodities that have battled their way into the public fancy through spirited competitive selling, while electricity has prospered so far largely by the inherent appeal of this new service that has offered man so many obvious benefits not otherwise obtainable.

But electrical men are passing now into a new era in which their minds will more and more turn to the arts of marketing, among which that printed salesmanship called advertising is so important. Fortunate it is that so much knowledge has been amassed in the advertising experience of other fields within the last two decades. With its period of growth by the accumulation of customers drawing to a close, the electrical industry now enters the marketplace to joust for a larger share of the consumer's dollar. In the modern practices of advertising it will find a sturdy shield and a well-tried lance ready to hand.

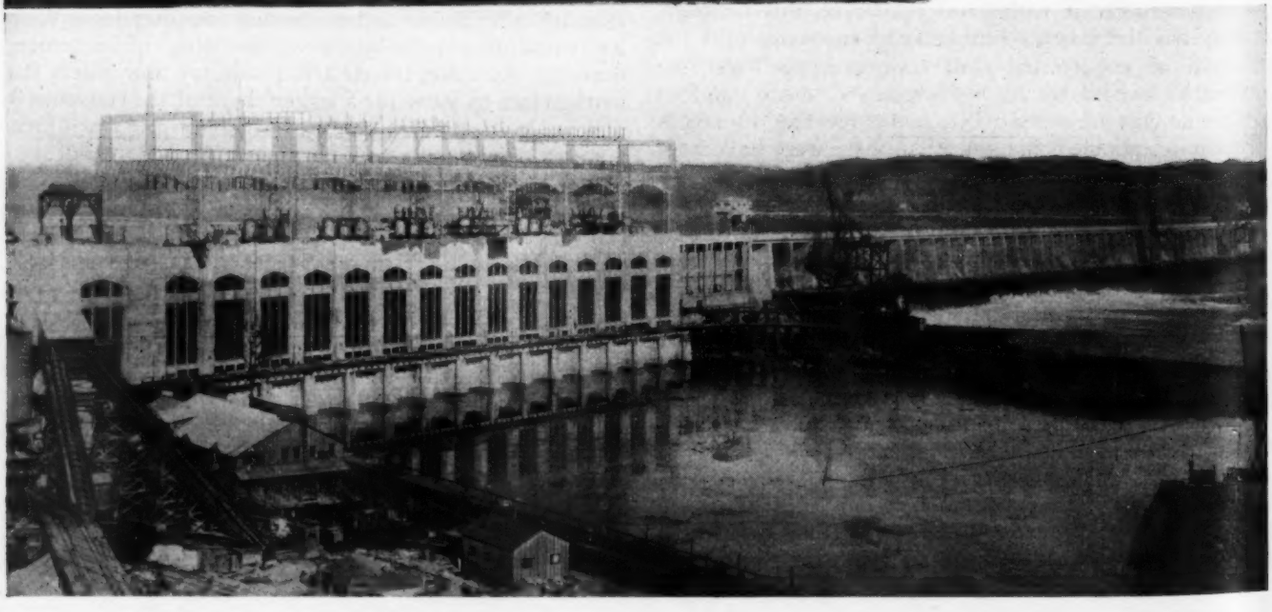
Mr. McGraw has been a pioneer in the development of the art of advertising in the electrical industry from the time that he acquired the ELECTRICAL WORLD, back in 1899. The industry then consisted of an unrelated and scattered group of small shops, factories and power houses. His fourteen publications have been a progressive force in many industries. They have worked for the elimination of unethical and uneconomic practices. By the study of industry's buying habits and the effective forms of marketing organization needed for industrial products they have done much to clarify industry's own appreciation of the requirements of industrial marketing, as contrasted with the development of sales to the private consumer. It was for his leadership in this creative service that the Harvard medal was awarded to Mr. McGraw.

Interconnection— A Major Topic at Institute Convention





EXPERIENCES with energy interchange in the Southeast, in Pennsylvania-New Jersey, in the Chicago district and on the Pacific Coast constituted the subject of an extensive symposium before the A.I.E.E. last week and are presented in this issue. East Point substation, near Atlanta, serving as the junction point for tie-lines from systems contiguous to the Georgia Power Company, is shown in part above. To the left are river-crossing towers for the 220-kv. lines connecting Conowingo hydro-electric development with the Pennsylvania-New Jersey interconnection loop. A recent view of the Conowingo plant of the Philadelphia Electric Company is below.



A·I·E·E· Winter Convention

in New York

MEASURED by attendance, the communication session of the winter convention of the American Institute of Electrical Engineers, held in New York City, Feb. 13-17, was the most popular, due undoubtedly to the joint session with the British Institution of Electrical Engineers conducted by means of transatlantic radio telephony.

From a purely technical point of view, however, the symposium on interconnection experiences really commanded the most attention, so that very lengthy excerpts from the papers are presented on pages 403 to 409, while the high points of the discussion may be found on page 396. The interest at other sessions centered chiefly around dielectric and lightning studies, automatic and supervisory control, automatic synchronizing and improvements in turbo-generators. Abstracts of all the papers are presented in this issue, as are also the major points developed in the ensuing discussions.

The ceremony at which the Edison and John Fritz medals were presented to Dr. W. D. Coolidge and Gen. J. J. Carty respectively and the customary dinner dance at the Astor constituted two of the formal occasions.

Control, Protective Equipment and Substations

Protection of Supervisory Control Lines Against Overvoltage

EDWARD BECK, Westinghouse Electric & Manufacturing Company.

Supervisory control lines used in the remote or automatic control of electric plants are subject to overvoltages dangerous to insulation and to operators. These overvoltages may be caused by lightning, crosses with the power lines, or induction from them. Cables with grounded sheaths are immune to disturbances caused by lightning or other electrostatic induction, and are more or less safe from crosses. However, the ordinary cable is still subject to high voltages by electromagnetic induction when a fault occurs on the power line in which it is included.

Even if apparatus locations are protected, high voltages may occur along the line and cause cable failure unless the cable is protected at intervals. Discharge currents of the order of 50 amp. for two seconds can be handled by a spark gap inclosed in argon under less than atmospheric pressure. Specially made cables will shield the line against extraneous disturbances.

Vacuum-Tube Synchronizing Equipment

T. A. E. BELT and N. HOARD, General Electric Company.

Potential from high-voltage circuits is obtained by means of capacitance transformers. This potential is applied to the grid circuit of vacuum-tube amplifiers, the output from which drives a rotating type of synchronoscope. Thus the vacuum-tube synchronizing equipment makes unnecessary costly high-voltage transformers, which have been almost universally used for synchronizing in the past. The capacitance transformer does not affect the electrical characteristics or functioning of the high-voltage bushing in which it is mounted. The ratio is constant under changes in weather conditions. The ratio of the capacitance transformer is not affected by voltage change of the system; it changes with decrease in shunt resistance, but is negligible with a decrease in resistance down to 300,000 ohms. The normal leakage resistance of the capacitance transformer is approximately 100 megohms, and therefore the ratio, which is 0.05 per cent at 50 cycles and 0.04 per cent at 70 cycles, may be considered independent of frequency. The phase-angle shift changes slightly with change in frequency, being 2.75 deg. at 60 cycles, 2.4 deg. at 70 cycles and 3.3 deg. at 50 cycles with a 600,000-ohm shunt resistance.

Automatic Control of Edison Systems

O. J. ROTTY, Union Electric Light & Power Company, and E. L. HOUGH, General Electric Company

The St. Charles Street substation of the Union Electric Light & Power Company has been operating fully automatic for somewhat over a year very successfully. In practically every case of system disturbance the automatic control appeared to function correctly. In one case particularly, when the Keokuk transmission circuits were completely disabled by a tornado and the load thus released was suddenly thrown on the steam plants, this control gear operated admirably over a wide range of frequency and alternating-current voltage and through severe direct-current load fluctuations until the system was again stabilized. At the time of the disastrous tornado of Sept. 29, 1927, none of the machines at St. Charles Street even dropped its load, although the a.-c. system was subjected to many severe short circuits and grounds. Increasingly complicated operations will be controlled automatically with still greater reliability in the future, according to the authors.

Lightning Experience

PHILIP SPORN, American Gas & Electric Company.

Performance of different sections of 132-kv. line reduced to a common basis, changes in tower design, work done to reduce lightning troubles at stations and efficacy of ground wire are related by the author. An extensive excerpt will be found on page 411.

Use of Condenser-Type Bushing in Synchronizing

E. E. SPRACKLEN, Ohio Public Service Company; D. E. MARSHALL and P. O. LANGGUTH, Westinghouse Electric & Manufacturing Company.

Describes apparatus recently developed for utilizing the charging current of a condenser bushing in operating a synchroscope. Operating data are given covering different conditions of frequency, voltage, etc. The voltage characteristic is practically a straight line regardless of burden. Phase-angle error is practically constant with variation in line voltage. Practically constant ratio is obtained for a given frequency. The more resistive secondary burdens flatten out the voltage-frequency performance. The power factor of the burden appears to have little effect on voltage performance, however power-factor change affects the frequency-voltage characteristic. The phase-angle variation with temperature change is negligible. The voltage variation amounts to 2½ per cent for a burden of 15-volt-amp. at 50 and 60 cycles. Although considerable distortion is obtained in the capacity circuits, the reactor smooths out all variations and produces a very good wave form in the secondary current through the burden. The burden voltage

drops with change of frequency above and below rating, the change being greatest for the heavier burdens. When two condenser-bushing potential devices are used for synchronizing the phase-angle error with change in frequency is about 2½ deg. for departures from rating of 7½ cycles.

JUDGING by the amount of discussion at this session the interest was about equally divided between protection of supervisory control circuits, lightning experience and new substitutes for the customary synchroscope coupling. Considering automatic control of Edison systems in St. Louis, Herman Bany contended that removing the batteries there indicates that automatic switching gives sufficient service reliability.

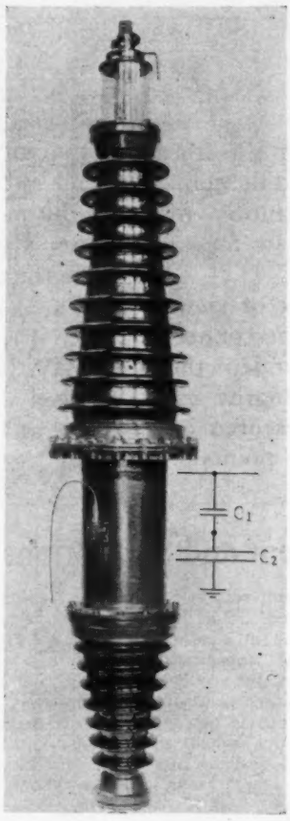
H. L. Wallau reported that automatic selection of buses is being employed with the synchronous converters in the latest Edison substations of Cleveland, but that no serious disturbance has occurred to test their functioning.

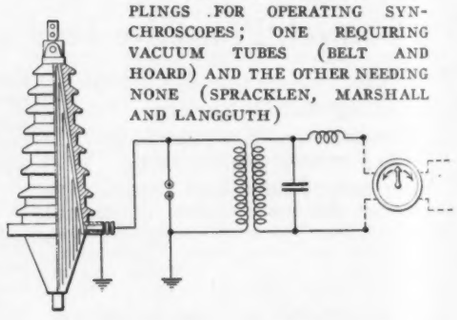
Opening the discussion on supervisory control protection, V. Boyd referred to an installation in Ontario of two control cables paralleling 44-kv. lines about 3 miles in which effective protection has been afforded by grounding each supervisory conductor through the primary of a transformer the secondary of which is connected to a supervisory equipment.

Chester Lichtenberg, pointing out that the success of supervisory control is predicated on continuous availability, declared that insulating transformers must be used when direct-current impulse and holding-coil currents are used on supervisory conductors paralleling high-tension lines. Choke coils will check electromagnetic disturbances and lightning arresters must be self-restoring. Power lines using carrier current for supervisory control have been protected on the Chicago South Shore Railroad by using pellet-type arresters, high-tension fuses and drainage coils.

C. Antoniono warned against the danger of power lines coming in contact with the lead sheath of supervisory cables, saying that the reliability of supervisory control is even more important than that of communication. A supervisory control line on the Chicago, North Shore & Milwaukee Railroad composed of both cable and aerial conductors and paralleling both 2,300 and 132,000-volt lines is protected by periodically spaced lightning arresters on the exposed sections, at each end of the cable, and by fuses in each circuit. Lightning has been found to cause most of the troubles experienced.

Alfred Herz declared that pilot-wire systems must also be protected against lightning. Mr. Beck, the author of a paper, closed by emphasizing the need of making ground resistance as low as economical.





TWO TYPES OF BUSHING COUPLINGS FOR OPERATING SYNCHROSCOPES; ONE REQUIRING VACUUM TUBES (BELT AND HOARD) AND THE OTHER NEEDING NONE (SPRACKLEN, MARSHALL AND LANGGUTH)

W. A. Kates declared that reputed effectiveness of arc-protecting devices is often minimized by the fact that there has not been sufficient segregation of the supporting data to make the conclusions convincing. Too infrequently are data collected on frequency and intensity of electrical storms and the basis for determining causes of outages is often superficial.

A. O. Austin submitted a discussion of some length, commenting chiefly on the value of ground wires. He also emphasized that performances of lines cannot be compared on a simple unit basis without taking into account clearances, intensity of storms, etc. Ground wires, he declared, reduce the stored potential in the protected conductors 30 to 40 per cent, so that the effect of a disturbance may spread farther beyond its sources than in the case where the stored potential is of great enough magnitude to dissipate itself rapidly through corona loss. Curves were presented indicating the relation between induced voltage and distances from disturbances with and without ground wires.

H. B. Vincent expressed the opinion that it would be interesting to hear how well arc-protecting devices guard insulators during surges; disturbances may never interrupt service and still damage porcelain.

Closing the discussion on lightning experiences, Mr. Sporn advised that the U. S. Weather Bureau has discontinued recording the frequency of lightning storms because it has found that new records merely corroborate what years of collected data have indicated. Consequently, utility operators can learn much about lightning in their territories by examining past lightning records of the bureau. In determining the causes of outages, the speaker pointed out that logs of interruptions are checked against relay records before deciding whether the cause of interruption was as indicated. Klydonograph records have indicated that no insulators designed for 1,100,000 volts flashover will break down as low as 400,000 volts even with oscillatory wave fronts such as suggested by Mr. Austin. Some grounding points on lines have been omitted with very satisfactory results, although the omissions were made for economy and not for the reasons suggested by Mr. Austin.

PORTION OF LOADING SEQUENCE CHART FOR ST. CHARLES STREET SUBSTATION (ROTTY AND HOUGH)

Load on Machine (Amp. at 250 Volts)				Total Load	Operating condition
No. 8	No. 12	No. 11	No. 7	on Station	
1000	0	0	0	1,000	**Minimum load**
					Load increases
8400	0	0	0	8,400	No. 8 gives signal to start No. 12
7000	1400	0	0	8,400	After No. 12 is on
					Load increases
7000	6300	0	0	13,300	Before No. 12 recalibrates No. 8
9000	4300	0	0	13,300	After No. 12 recalibrates No. 8
9000	6800	0	0	15,800	No. 12 gives signal to start No. 11
					Etc. up to
9000	7200	7200	7400	30,080	**Maximum load**

Load on Machine (amp. at 250 Volts)				Total Load	Operating condition
No. 8	No. 12	No. 11	No. 7	on Station	
9000	7200	7200	7400	30,800	**Maximum load**
					Load decreases
9000	7200	3000	7400	26,000	Before No. 11 decalibrates No. 12
9000	5200	5000	7400	26,600	After No. 11 decalibrates No. 12
					Load decreases
9000	5200	1000	7400	22,600	No. 11 gives signal to shut down No. 7
9000	7200	5400	1000	22,600	No. 7 reduces load, preparatory to timing off
9000	7200	6400	0	22,600	After No. 7 is off
					Etc. down to
1000	0	0	0	1,000	**Minimum load**

Grading rings on 132-kva. insulators have not been found to increase their flashover value, but arc-protection devices have greatly avoided burning and breaking of the porcelain.

Because of the lateness of the hour very little opportunity was afforded for discussions on the new synchronizing equipment. E. D. W. Eby announced that the vacuum-tube synchronizing device is being compared with the ordinary synchroscope on a 110-kv. system to ascertain the relative accuracies.

Mr. Lund reported that the Metropolitan Edison Company has had very good experience with vacuum-tube synchronizing, even when the capacitance transformer bushing flashed over due to lightning. The apparatus is rather complicated but very reliable, he commented.

Mr. Langguth suggested four general uses for the new condenser type bushing: Synchroscope, frequency meters, voltmeters and relaying.

Mr. Marshall pointed out that a synchroscope can be connected with this bushing and operated without any intervening apparatus except a transformer, reactance, capacitance and a spark gap.

Electrophysics and Dielectrics

Surge Impulse Breakdown of Air

J. J. Torok, Westinghouse Electric & Manufacturing Company

Describes a phenomenon used to study the development of high-voltage spark-over. It has been found that if a voltage which is more than sufficient to cause breadown of a sphere-gap is applied and then very quickly reduced to a low value luminous streamers are produced instead of the usual intense spark. These streamers, which represent the intermediate stage between the initiation of and actual flashover can be recorded on a photographic plate by the use of a quartz lens. The effect on time lag of flashover, with special reference to the state of ionization of the gas previous to flashover, is also discussed. This method of "suppressed discharge" has also been used to determine the electrostatic field around insulators and between electrodes of various shapes.

Approximate Solution for Highly Oscillatory Networks

E. A. Guillemin, Massachusetts Institute of Technology

The general solution for the slightly damped network is expressed in terms of the undamped solution by means of series expansions. The first part of the paper gives a method for evaluating the complex roots of the determinantal equation, and the second part shows how the expansions of the first part may be correlated with the Heaviside formula to form the complete approximate solution. An example illustrates the application to a simple network.

Boltzmann-Hopkinson Superposition Applied to Dielectrics

F. D. Murnaghan, John Hopkins University

This paper shows that the principle of superposition is a necessary consequence of Maxwell's theory. It goes somewhat further and shows that the principle is valid for any theory which leads to a system of linear differential equations with constant coefficients.

Influence of Internal Vacua and Ionization on Cable Life

Alexander Smouroff and Leo Mashkileison, Electrochemical Institute of Leningrad, Russia

Preliminary results of research show that internal vacua of the order of 350-400 mm. of mercury may appear in a cable under the influence of temperature changes and ionization of air, noticeably lowering the life of the cable. To prevent the dangerous effect of internal vacua the following recommendations are made: (a) Use of chemically stable compounds; (b) arrangement of ducts within the cable to maintain atmospheric pressure; (c) pumping of dry air through ducts in cable to maintain a pressure higher than atmosphere; (d) filling a cable with transformer oil under pressure to compensate volume changes of air in cable.

The Earth's Electric Charge

W. F. G. Swann, Director of Bartol Research Foundation, Franklin Institute.

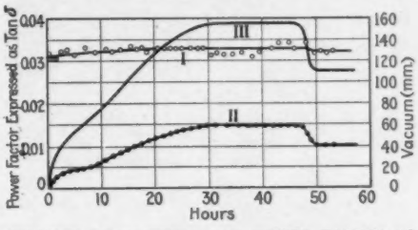
A new theory to account for the earth's magnetic charge was offered in this lecture. It was suggested that a slow death of positive electricity might be taking place on earth, leaving an excess of negative electricity to cause the earth's electrical charge under the influence of rotation. This idea may be incorporated in a consistent scheme of electrodynamics and at the same time provide an explanation of the earth's magnetic field. The theory suggests a possible origin for the known magnetic field for sun spots, and according to one interpretation, the velocity of matter in the sun spots need be no greater than about 80 km. per second in order to provide for the magnetic activity which they exhibit. It appears that the replenishment of the earth's charge could be accounted for satisfactorily by supposing that each cubic centimeter of the atmosphere supplies three electrons per cubic centimeter per second, and that these electrons are of such speed that they can travel a distance of 9 m. in air without absorption.

SUPPLEMENTING Mr. Torok's paper, C. L. Fortescue explained that the streamers in the sphere gap were due to molecular dissociation of the air. He mentioned that all severe lightning discharges may be considered to be of the negative-cloud type.

J. Slepian added that the slowness of ions returning to the cathode, in the case of sphere-gap discharge, constitutes a fundamental difficulty in applying the Townsend theory and that the single passage of the initiatory electron is sufficient to cause breakdown, the trail being highly conducting.

F. W. Peek, Jr., concluded, as a result of early investigations, that time lag is not a constant, but depends upon the rate of voltage rise and that spark-over voltage is different for lightning, needle-point and sphere-gap conditions. He reported that lightning surges always cascade over insulator strings, while 60-cycle impulses may or may not do so, the latter being automatically dissipated by the corona due to gradual application of potential. Horn gaps are not considered to increase spark-over voltages, although arcing rings may do so.

Considering the paper on cable life, William Del Mar suggested that the

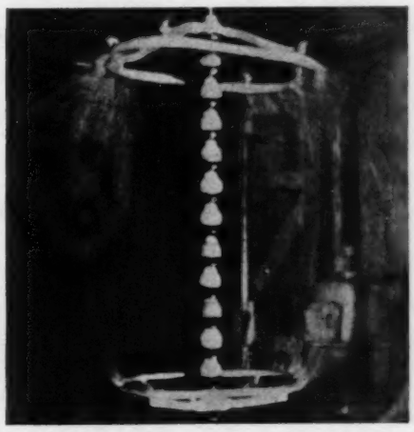


CHANGE OF VACUUM AND POWER FACTOR AS RESULT OF PROLONGED LIFE TEST (SMOUROFF AND MASHKILEISON)

(I) Power factor; (II) observed vacua; (III) vacua corrected for parasitical volumes.

ability of a cable to absorb large quantities of oil from reservoir joints is possibly a heat-cycle action in which the expanding oil deforms the sheath but on cooling leaves voids, which are gradually filled by capillary action from the reservoir supply. The cables used by Smouroff and Mashkileison were judged to have been low-life specimens, differing considerably from American materials.

C. L. Dawes cited four experimental parameters to be considered: Voltage, frequency, thickness of air space, and pressure. He declared that it is incorrect to "assume the loss angle of the dielectric proper (without air) to have



ELECTROSTATIC FIELD AS MODIFIED BY ELLIPTICAL RINGS (TOROK)

a constant value and neglect the small variations of cable capacity with increase of voltage."

W. F. Davidson pointed out that the arrangement used by the authors for the test terminal permits the cable to pick up stray charges and possibly influences the results.

E. H. Salter suggested that the quality of cable used by the authors was

apparently inferior to standard American products, judging from the results obtained. He also added that forcing air into and out of the cable specimens produces misleading effects, as in installed cables the quantity of air is unvarying, although the pressure changes with the heat cycles.

L. H. Conlin observed that the flat characteristics obtained in the prolonged life test were due in part to the air path produced in connecting the manometer and that the indicated results were caused by the using up of the oxygen content. Chemically stable compounds are necessary, declared the speaker, only to resist oxidation. The use of transformer oil was discounted for cable impregnation, as light oil, due to low reservoir pressures and rapid losses, will not prevent void formation even at short distances from the joint.

E. S. Lee contended that pressures in cables above atmospheric were conducive to long life, while those below atmospheric have the opposite effect, according to power-factor curves.

R. J. Wiseman added that full saturation is desirable and suggested alternate high and low pressure reservoir joints so that air can be forced to low pressure points and to maintain saturation.

Commenting upon Prof. Murnaghan's paper, V. Bush declared that the principle of superposition depends upon the validity of the assumption that each increment has the same fundamental characteristics.

E. R. Le Ghait stated that a close study of apparent contradictions in the theorem may lead to new light on the materials involved.

O. G. Marti showed that the principle of superposition does not hold unless the linear relation between time and quantities is not exceeded.

J. Slepian felt that undue prominence has been given to Maxwell's theorem of dielectrics and that if small enough voltages are used the quantities will appear to be linear. Dr. Slepian added that many a memoir on the mathematics of physics is vacuous of physics and, so far as the principle is concerned, expressed extreme skepticism on the value of the principle of superposition for obtaining further knowledge regarding dielectrics.

V. Karapetoff, the chairman, added that the situation was "macrocosmomorphic"; that is, built like the big world —in which the viewpoint of finding the unknown in terms of the familiarly surrounding is evidenced.

Interconnection and Power Development

Progress and Problems of Interconnection in Southeastern States

W. E. Mitchell, Georgia Power Company.

Interconnection and Power Development in Chicago District

H. B. Gear, Commonwealth Edison Company.

Conowingo and Philadelphia, with Reference to Interconnection

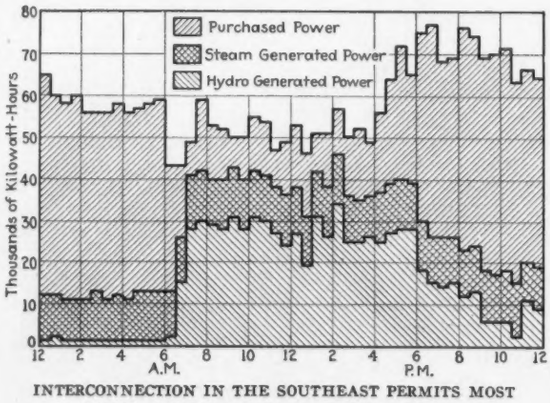
The late W. C. L. Eglin, Philadelphia Electric Company.

Aspects of Pacific Coast Interconnections

P. M. Downing, Pacific Gas & Electric Company.

EXPERIENCES with interconnection in the Middle Atlantic States, Southeast, Chicago district and Pacific Coast were ably presented by the authors indicated above, whose papers are abstracted quite extensively on page 403 of this issue. To make the discussion still more embracive of the subject as well as of the talent in the electrical field, nine well-known men in the utility field were called upon.

Charles L. Edgar contended that load dispatching is the heart of successful interconnected operation. Executive as well as engineering problems must be solved. Interruptions from lightning and switch or insulator failure are to be expected until more study is given to minimizing the disturbances caused thereby. Spectacular interconnections like the Chicago-Boston-Pensacola tie are merely demonstrations of the feasibility of parallel operation and possibility of exchanging energy between adjacent systems. But many tie lines have inadequate capacity for great transfer of power. Electrical interconnection, like the Lincoln Highway, merely permits transport between adjacent cities or territories and is not intended primarily for through transport.



INTERCONNECTION IN THE SOUTHEAST PERMITS MOST FLEXIBLE COMBINATIONS OF STEAM, HYDRO AND PURCHASED POWER (MITCHELL)

A. C. Marshall pointed out that the chief benefits of interconnection come from diversity of various kinds: Diversity of daily and annual load, generator capacity, latitude and longitude, construction programs, population, habits of living, industry, etc. Therefore it is impossible to imagine two systems which have identical characteristics; so the value of interconnection is widespread. Executives are chiefly interested in interchange agreements that will not require a Philadelphia lawyer and a Schenectady engineer to interpret.

James Lyman reported that sixteen years experience with interconnection in the Middle West had shown that voltages which were once considered adequate had to be increased to as high as 132 kv. A map of the 66 to 140-kv. lines in the Great Lakes region tells an entirely different story than a map of all the lines. Plots of 132-kv. line characteristics show that power factor influences decidedly the kilowatt-miles that can be transmitted. Ground wires and insulator shielding rings have been found to reduce interruptions considerably. Tie lines rated at 132 kv. and 50 to 60,000 kva. per circuit have been found adequate for the Middle West. Among the possible advantages of interconnection recited were: Availability of power to markets, favorable location of plants, load factor due to diversity, necessity of less generating capacity and reserve, increased reliability, staggered construction, normal and emergency exchanges of power.

Financing of interconnection is no kindergarten problem, declared Farley Osgood. Large investments are needed years in advance of the full income expected. Most rugged construction is essential to reliability of interconnection service and avoidance of duplicated expense. He cautioned his audience to design tie lines for high voltages initially so that they will not have to be scrapped for higher voltages. Rotary condensers were recommended on the customers' premises and favorable rates were urged to encourage their purchase by customers. Elimination of solid ties was suggested as a means of avoiding severe interruptions. High-voltage cable is greatly needed in congested territories. Every possible recording device which will enable studying experiences under abnormal conditions are desirable, as infallible data constitute the only guide to proper procedure. "Let no argument remove any appropriation therefor from the budget," he urged.

Interstate transmission involves legal and political aspects, declared E. C. Stone, that every engineer should recognize if he is to develop interconnection unhindered. The chief trouble lies in the inability of laymen to distinguish electric services from other utility services, largely because the kilowatt-hour cannot be traced in its course. While only 9 per cent of the energy generated crosses state boundaries, hindrance of interstate transmission will curtail its use by utilities to the detriment of the public.

L. W. W. Morrow corroborated the 9 per cent figure for interstate transmission and pointed out that 26 per cent of that transmission involves no change in ownership and that 16 per cent is interchange energy as compared with regular supply. The leading states in export and import of power have unusually large power plants and markets respectively. There is no reason to expect as great a growth in interstate transmission as in total energy growth.

All large water powers will soon be developed, declared W. S. Lee, who contended that markets should be served from the nearest power sources for economy. To fulfill their obligations to the public utilities will build water power where available and intersperse steam plants. Interconnection was favored only as a means of shortening transmission distances and not to carry large blocks of power long distances.

Loose-linkage interconnection, explained C. F. Hirshfeld, is to permit a system to separate readily when in trouble and to allow the parts to operate independently. Such a system remains intact under controllable or easily cleared troubles, but the portion in which uncontrollable trouble occurs is isolated and must shift for itself. Loose-linked systems comprise a collection of service areas, each of which must become self-sustaining instantly when trouble arises, but which operate in parallel normally. Reserve is necessary to make each area self-sustainable, but each area does not carry its own load independently normally. The boundaries of the service areas and interconnections are not fixed, but are shiftable to permit separation in an emergency with the least disturbance. Plants so connected can be operated for the best combined thermal economy, but some efficiency is sacrificed as the price of service protection. Such operation requires a higher degree of engineering and operating skill than solid-tie systems, it was contended.

F. A. Allner contended that there are advantages in interconnection even if two systems have identical characteristics, which is difficult to imagine. Benefits come from saving reserve capacity, ability to stagger construction and emergency exchanges of power. Hydro units can be synchronized quicker than steam, advised the speaker.

Electrical Machinery

Reactances of Synchronous Machines

R. H. Park and B. L. Robertson, General Electric Company

Part I treats those factors which are important to application or operating engineers and to designers. Synchronous, transient and phase-sequence reactances are defined and their methods of test outlined. A table is included which gives the numerical range of reactances for the various types of synchronous machines. Part II discusses the theoretical considerations, such as the effect of external reactance on negative phase-sequence reactance. Transient reactance is shown to be the difference between synchronous reactance and the ratio of the mutual reactance between armature and field and the total field reactance. Calculations are included to show that the short-circuit and open-circuit time constants are related to each other in a simple manner.

Synchronous Machines—IV

R. E. Doherty and C. A. Nickle, General Electric Company

Four basic concepts underly the theory presented: (1) Characterization of the machine by four reactance coefficients, two corresponding to the main pole axis, i.e., direct axis, and two to the interpolar axis, i.e., quadrature axis; (2) resolution of flux and m.m.f. waves traveling with respect to the rotor into stationary, pulsating components in line with the direct and quadrature axes; (3) that the variable component of armature inductance varies between the direct axis value and the quadrature axis value as a second harmonic function of the electrical space angle. Each quantity in equations is expressed as a decimal fraction of "normal" value.

Expressions are derived for the short-circuit currents in the armature and field, for voltage induced in the open phase, and for voltages across external reactances in the armature and field circuits. The short circuit currents are expressed as the sum of two series, one of odd, the other of even harmonics, in which the magnitudes of the harmonics in ascending order are in geometric ratio. It is shown that although voltage induced in the open phase during single-phase short circuit may be fifteen or twenty times normal in a laminated, cylindrical rotor machine without amortisseur circuits, it may be only two to four times normal in a salient-pole machine. An amortisseur winding greatly reduces it in either case.

Calculation of Armature Reactance of Synchronous Machines

P. L. Alger, General Electric Company.

The author presents new and simplified formulas for the armature reactance of synchronous machines and compares the results obtained with tests on 100 machines of various types. The new formulas are characterized by unusual expressions for the end leakage and for the air gap or differential leakage reactances. Formulas for zero phase-sequence reactances are given. The definitions of armature leakage and armature reaction reactances used are those proposed by Doherty and Nickle in 1926. As a result the leakage reactance has a much smaller value than has heretofore been assigned to it, thus requiring a rather fundamental revision of the ordinary conceptions of the flux densities existing in the various parts of a loaded synchronous machine.

The Thermal Volume Meter

C. J. Fechheimer and G. W. Penney, Westinghouse Electric & Manufacturing Company.

A development of the original device of Professor Thomas. The principle involved is that of raising the temperature of a gas by means of an electrical heater, the change in temperature being accurately measured either by means of a thermopile or resistance thermometers connected in a wheatstone bridge network. The thermocouple method is offered as being preferable to resistance thermometers and most of the consideration is devoted to that type of construction. A sufficient number of thermocouples is required to give a good reading of the potentiometer with a comparatively low temperature rise of the gas, and also to obtain a good average of the gas temperature. The details of construction, the equations for calculating the volumes of gas and the possible sources of error are included.

THE three papers regarding synchronous machines constituted a unit and were presented as such. F. D. Newbury, chairman, in discussing the contributions, mentioned the increase in the number of known reactances for which allowance must be made, from the original two of earlier days of design work to an essential seven and generally accepted thirty-one.

A. E. Kennelly suggested that it was highly important that the useful concepts regarding reactance and other synchronous machine factors which were included in the various papers be clearly tabulated and classified so that in speaking of the reactances of synchronous machines it may be mutually understood just which ones are involved. The suggestion to express the figures in unit values rather than in per cent terms received particular approval.

As a result of investigations conducted with salient-pole and cylindrical-rotor machines J. J. Linebaugh derived curves, both theoretically and experimentally, which check very closely. The effect of salient-pole and amortisseur windings was indicated by voltage and current curves.

B. A. Behrend praised the work of the investigators who had made their determinations with such mathematical preciseness, but suggested that it is sometimes wise to compromise with knowledge to secure simplicity. The futility of accuracy in design greater than that which can be imparted in construction was suggested as a consideration not to be overlooked.

R. Treat pointed out that the growth of knowledge regarding synchronous machines requires continually diminishing numbers of empirical constants and factors. Complications are reduced by a realization of the comparative unimportance of certain factors. The work of the authors was foreseen as a basis for determining with considerable reliability the effect of synchronous machines upon oil circuit breakers, relay operation and the general stability of systems to which they are connected.

W. V. Lyon contended that the mathematical side of the question had not been overstressed and that the papers afforded a steppingstone to a more complete solution of the general problem involved in the use of synchronous machines. It was also his contention that the phrase "tran-

sient reactance" is a misnomer, as reactance depends upon frequency.

W. F. Dawson expressed the opinion that the assumption of sinusoidal wave form made in preparing the surge-curve envelope leads to errors, as great as 25 per cent in some cases. These errors often lead to the specification of larger oil circuit breakers and equipment than necessary. He suggested that r.m.s. values of the wave shape be employed.

H. H. Spencer suggested the possibility of using superposition in preparing these curves and computing circuits.

A. A. Bennett objected to the analyzing of functions in Mr. Alger's paper, contending that it is unreasonable to resolve into components vectors which do not reasonably exist as such in a machine.

In closing the discussion Mr. Doherty defended the inclusion of details in the determinations, but agreed that it is permissible to neglect certain factors if it can be demonstrated that they are comparatively insignificant. The thirty-one reactances considered in the paper reduce to only seven in actual practice, it was pointed out. Mr. Park reported that detailed treatment of three-phase phenomena is not available now, but may be in the future. He also concurred with Mr. Dawson's comment regarding the sinusoidal wave forms.

Considering the thermal volume meter, W. F. Dawson stated that this device has proved almost indispensable for the investigation of significant conditions involved in turbo-alternators and similar classes of electrical machines. By employing resistance coils instead of thermocouple instruments measurement within one-tenth of 1 deg. can be obtained.

Mr. Fechheimer advised that he had conducted his original measurements with resistance thermometers, but not with the stream-line device mentioned by Mr. Dawson, although this expedient may have certain advantages. However, an accuracy of one-tenth of 1 deg., when total variations of only 2 deg. are to be measured, was not considered satisfactory by the speaker. The use of a number of thermocouples, as described in the paper, was suggested as a satisfactory solution of the temperature recording difficulty.

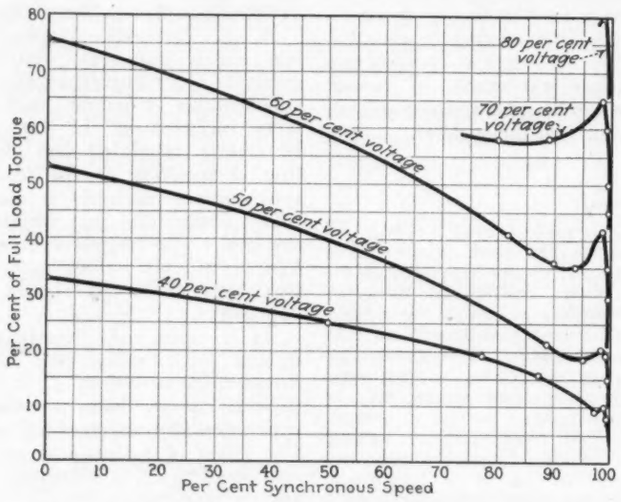
Electrical Machinery

(SECOND SESSION)

Effect of Transient Conditions on Compound Motors

L. R. LUDWIG, Westinghouse Electric & Manufacturing Company.

When a direct-current compound motor is started the rise of current in the series field induces a counter potential in the shunt field and the current may reach several times normal value in a negative direction. This produces the effect of differential compounding and causes the starting torque to be materially reduced. Where the motor is continually started and stopped the effect may be so serious as to dictate the choice of another type of motor. In case the compound motor is disconnected from the line while running and reconnected with no external resistance, the delay in establishing a flux, due to the damping action of the shunt field, may permit excessive currents to flow. A study of such transients leads to means by which they may be minimized and suggests methods for predetermining motor behavior.



TORQUE SPEED CHARACTERISTICS OF TWO-POLE SYNCHRONOUS MOTOR AT VARIOUS VOLTAGES (MCLENEGAN AND SUMMERS)

Design and Application of Two-Pole Synchronous Motors

D. W. MCLENEGAN and IVAN H. SUMMERS, General Electric Company.

The synchronous characteristics of the two-pole motors are similar to those of lower speed salient-pole machines. In sizes smaller than 800 to 100 hp. at 3,600 revolutions per minute the synchronous motor is hardly competitive with the squirrel-cage or the slip-ring motor unless the need of power factor improvement justifies a considerably higher first cost. The two-pole synchronous motors now in service are used to drive centrifugal gas boosters or centrifugal air compressors in connection with sewage disposal or copper refining processes. Since the two-pole synchronous motors are of large ratings and necessarily have low reactance, it is important to design the control equipment to start and accelerate the motor with the lowest possible inrush. In general, if a synchronous motor falls more than a few per cent below synchronous speed, due to momentary voltage drop, it will not resynchronize upon return of voltage. However, if the direct-current excitation can be removed and the oil-circuit breaker in the armature circuit remains closed the motor can resynchronize provided the squirrel-cage torque at subsynchronous speeds just below synchronous is sufficient to carry the load.

Heat Losses in the Conductors of a Direct-Current Armature

W. V. LYON, E. WAYNE and M. L. HENDERSON, Massachusetts Institute of Technology

The armature copper loss in a direct-current generator is not correctly computed by squaring the armature current and multiplying by the measured armature resistance between brushes, because the disturbance produced by the commutation persists throughout the cycle, so the current is not uniformly distributed over the cross-section of the conductor. To find the extra losses the vector method of analysis is employed, assuming that the time variation of the coil current is trapezoidal and computing the losses for each harmonic component as previously described by W. V. Lyon and I. H. Summers. Where several coils are side by side, as is usual in a d.-c. armature, the average extra loss is computed as if the coils that are side by side were connected in parallel and carried the vector sum of the currents in these coils.

Improvements in Turbine Generators

S. L. HENDERSON and C. R. SODERBERG, Westinghouse Electric & Manufacturing Company.

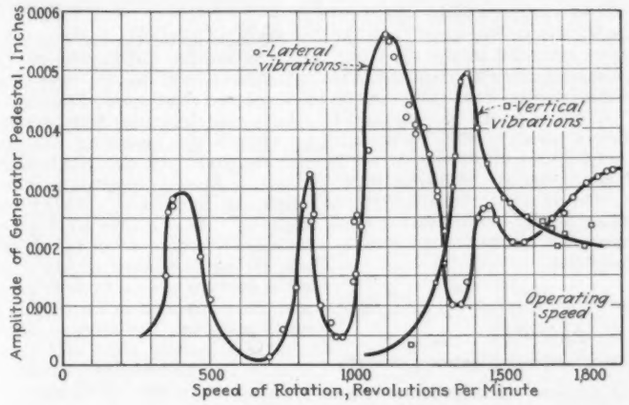
Both electrical and mechanical improvements are covered. Multiple radial distribution has diminished the ventilation problem of large units. Provisions for hydrogen cooling are being made. Eddy currents are being avoided by coil and strand transposition. Swelling and wrinkling of mica-folium is being avoided by a new bond and semi-conducting corona shields are proving effective for coil insulation. Generator voltages as high as 22,000 are being used. Stators are being built of steel almost equivalent electrically to that used in transformers. Non-magnetic material is avoiding trouble with coil-retaining rings and finger plates. No indications of instability have been observed with 0.8 to unity short-circuit ratios. Structural steel skeleton frames have revolutionized stator construction and built-up plate rotors and one-piece rotor forgings have simplified rotor construction. With a multiplicity of resonance frequencies or critical speeds the problem is to design machines so they will operate in the valleys of resonance curves.

DISCUSSION at the second session devoted to electrical machinery centered chiefly around recent improvements in turbine generators. W. J. Foster advised the audience that two plants have already selected a generator voltage of 22,000. Referring to the swelling of mica-folium, he pointed out that there are better bonding materials than shellac when high temperature

must be withstood. To prevent corona deterioration, insulated metallic sheathing has been tried out, but it was not permanent. A sheath is needed which adheres closely to the insulation and does not deteriorate electrically or chemically. Hydrogen cooling benefits rotors more than stators.

Stress charts developed twenty years ago were displayed by B. A. Behrend, who referred to the failure of the old Niagara generators and concluded that the construction employed and not the calculations were at fault. Plate-type rotors are favored by the speaker, who claims that forging a hole in a rotor reduces the strength in a critical direction.

Solid rotors were recommended by M. D. Ross for large synchronous motors so that they may be made self-starting, the same as smaller machines. The number of starts which can be made depends on the heat storage capacity of the rotor. Salient-pole motors will pull into synchronism without excitation. The speaker expressed the hope that better knowledge of the characteristics of two-pole synchronous motors would open their field of application.



RESONANCE OCCURS AT SEVERAL SPEEDS—UNIT MUST BE DESIGNED TO OPERATE AT INTERMEDIATE VALUES (HENDERSON AND SODERBERG)

Two discussions from abroad were presented, one by Edouard Roth and the other by A. B. Fields. The former declared that skeleton-frame generators have doubtful value in England. Leakage slots give great stability without increasing short-circuit ratio appreciably. Heating of end plates can be avoided by using non-magnetic metal. Thin mica and a small percentage of bond avoid swelling of mica-folium, declared the author of this discussion, who referred to a French machine for producing homogeneous insulation. Solid steel forgings are being used for rotors as large as 75,000 kva. Mr. Fields suggested more consideration of water and oil cooling of rotors.

A new type of steel was mentioned by W. J. Merton for retaining rings and poles. He referred to the improved physical characteristics which can be obtained by heat treating rotor forgings or subjecting them to high-frequency magnetization.

R. W. Owens, referring to the operating requirements of centrifugal gas compressors, emphasized that they must operate at 10,000 to 20,000 r.p.m. The starting requirements are low, as motors require only 30 to 40 per cent full voltage to start. For this reason he recommended solid rotors to obtain the starting effect.

R. B. Williamson contended that ventilization is no longer a limit to machine size and that laminated conductors have overcome the eddy-current bugbear. The real limit to size is shipping weight (approximately 200,000 lb.), so rotors constitute the limiting factor. Great difficulty is experienced in securing sound castings free from hair cracks. To avoid these the forgings should be made from freshly poured billets. Coil-retaining rings are almost limited to alloy steel and this is usually brittle. Attempting to utilize metals with a higher tensile strength than 85,000 lb. per square inch was not favored by the speaker. Overheating of end rings and development of flaws may result from single-phase operation. To prevent starting of hair cracks it was suggested that end rings be machined.

S. L. Henderson reported that the permanence of the corona shields mentioned in his paper has been tested. No tooth failures have been experienced in five years with silicon-steel stators.

C. R. Soderberg advised that the only way to improve the character of carbon steel is to heat treat it. The stresses caused by forging a hole in a rotor are not objectionable if kept within control. Solid disks do not have sufficient advantage over disks with a hole to warrant substitution, in the speaker's opinion. Great improvement in materials available is shown by micro-photographs. Unexpected faults in materials are more responsible for troubles than miscalculations. This speaker also contended that it is not wise to increase the tensile strength at the expense of ductility.

The remaining discussion at this session was less extensive and referred to the other three papers. I. H. Summers expressed favor for squirrel-cage windings over solid rotor construction for starting effect because the characteristics are controllable. Furthermore, the pull-in torque close to synchronism is high. D. W. McLenegan agreed that reactance starters are ideal when the impedance of the motor increases rapidly, but are not desirable for two-pole synchronous motors. In the control apparatus described in his paper the auto-transformer circuit is not interrupted, so the in-rush current is limited.

R. F. Franklin cautioned that an attempt to reduce excess direct-current armature losses may harm commutation and said that there are conflicting operating requirements where flux is considered.

B. A. Behrend briefly reviewed the literature available on eddy-current losses and expressed the hope that a complete study of the subject would be made some time. He criticised the A.I.E.E. publications committee for failure to print some scientific papers which have been given great attention abroad.

Communication

Transatlantic Telephony—The Operating Problem

K. W. WATERSON, American Telephone & Telegraph Company.

The economic features of rates, service, company policy and personnel for transatlantic telephone communication and statistics on the anticipated value to subscribers are given by the author. The uniformity of charge bases and the methods by which the operating divisions of the American and European systems co-operate are outlined. Calls average seven a day, are about evenly divided between hemispheres of origin and, with the exception of some 5 per cent, are carried on in English.

Certain Topics of Telegraph Transmission Theory

H. B. NYQUIST, American Telephone & Telegraph Company.

Solutions have been derived previously for lines with simple terminal conditions, but, according to the author, it has long been recognized that the extension of the same methods to the more complicated terminal problems leads to great difficulties. This problem has been attacked from the alternative standpoint of steady-state characteristics. This method has the advantage that it does not complicate the calculations materially. The criteria for distortionless transmission are expressed in terms of the steady-state characteristics. The minimum frequency range required for transmission at a given speed of signaling is considered. A comparison of single side-band and double side-band transmission for carrier telegraphy is presented.

Loudspeakers of High Efficiency and Load Capacity

C. R. HANNA, Westinghouse Electric & Manufacturing Company.

Elements considered in the design of high-quality air-column loudspeakers with moving coil drivers are enumerated and described. Efficiency and maximum output capacity are calculated. The methods which may be used for providing sound

volume greater than that possible with a single loudspeaker are described. The author has proceeded upon the basis that the moving-coil driver offers the most suitable means for the transformation of electrical energy into mechanical energy in loud-speaking equipment. It is also his acceptance that the exponential type of horn offers the most suitable device for mechanical-acoustical energy transformation. A horn with a low rate of expansion and a large mouth has been used in this work. A device employing three elements with individual horns has been developed, not to increase tone quality, but to secure an increased volume.

Transatlantic Telephony—The Technical Problem

L. B. BLACKWELL, American Telephone & Telegraph Company.

An outline of the design and construction problems involved in the present transatlantic telephone communication facilities. The equipment in North America and on the other side of the Atlantic and the fundamental considerations which influenced the specification of the diversified devices used are mentioned. Single sideband carrier transmission is used in this work and through the necessary arrangement of switching devices the circuits are energized only during speech transmission resulting in reduced energy of consumption and interference. Separate paths are used for east and west-bound communication. While long waves are used as standard, the short-wave circuit from England to the United States is reserved for emergency use. The advantages derived through proper selection of geographical placement of stations and of minor refinements are reflected in the conservation of transmitted energy throughout the telephone system.

FOLLOWING the presentation of the papers of Messrs. Blackwell and Waterson, a joint session of the American Institute of Electrical Engineers and the Institution of Electrical Engineers (England) was conducted by means of the transatlantic telephone facilities. Archibald Page acted as joint chairman. Speakers included Bancroft Gherardi, John J. Carty, F. B. Jewett and H. P. Charlesworth in America, Archibald Page, T. F. Purves, Sir Oliver Lodge and Colonel Lee in England. President Gherardi spoke of this occasion as but a further step in bringing widely separated groups together. President Page paid tribute to the work of American telephone engineers through whose work this development became possible. The joint meeting was mentioned by Colonel Purves as but another proof of the "internationalism of engineering" In seconding a resolution of satisfaction over the consummation of this event, proposed by General Carty, Sir Oliver Lodge expressed the hope that "no word of hostility be ever spoken between the English-speaking peoples."

In discussing Mr. Hanna's paper on high-efficiency and high load-capacity loud speakers, H. Fletcher commended the determination of efficiency by two additional methods as well as by calculations and mentioned that while Mr. Hanna's device produced approximately 40 per cent over-all efficiency, several commercially available designs could be said to attain 50 per cent. The derivation of the experimental response curve shown in the paper was a matter of inquiry, as was the use of the equation for diaphragm thickness which gave values nearly twice those thought necessary by Mr. Fletcher for the purpose of avoiding resonant vibrations.

A. E. Kennelly suggested the use of electric circuit terms in the new "acoustical" circuit work in order to simplify the nomenclature for investigation and study in the latter field. Acoustic impedance and ohms were specific recommendations.

The diaphragm-thickness formula was reported by Mr. Hanna in his closing remarks to represent the values indicated as desirable according to the result of his experience.

Arc Welding

The Stability of the Arc Welding

P. ALEXANDER, General Electric Company.

The stability of the iron welding arc is influenced by a number of factors, such as the nature and the aerodynamic state of the surrounding atmosphere, the strength and distribution of the magnetic field, the composition of the electrode, the nature and the amount of gases occluded in the electrode, etc. The cooling of the electrode and the arc core has the preponderant influence on the stability of the arc. If the vapors of alkaline earths or alkali metals be present in the space between the electrodes, striking and maintaining of the arc would be much easier than in air. It requires much greater voltage to strike an arc with water-cooled electrodes than with electrodes allowed to become incandescent.

Welding and Manufacturing of Large Electrical Apparatus

A. P. WOOD, General Electric Company

The present tendency is to produce large electrical machinery from welded steel plates, thereby practically eliminating the pattern shop and foundry. By making these large structures of fabricated plates, no expensive patterns are required. Valuable pattern storage space can be used for other manufacturing purposes. Foundry space is reduced and the substitution of welded forms for castings results in a great saving of time and eliminates the possibility of a defective casting due to cores shifting, blowholes, cold shots and pouring gates, which require time to burn and machine off. The work of the machine shop is reduced to a minimum, as the plates arc-welded together have approximately the finished dimensions, whereas a casting requires excessive machining.

Effects of Surface Materials on Metallic Arc-Welding Electrodes

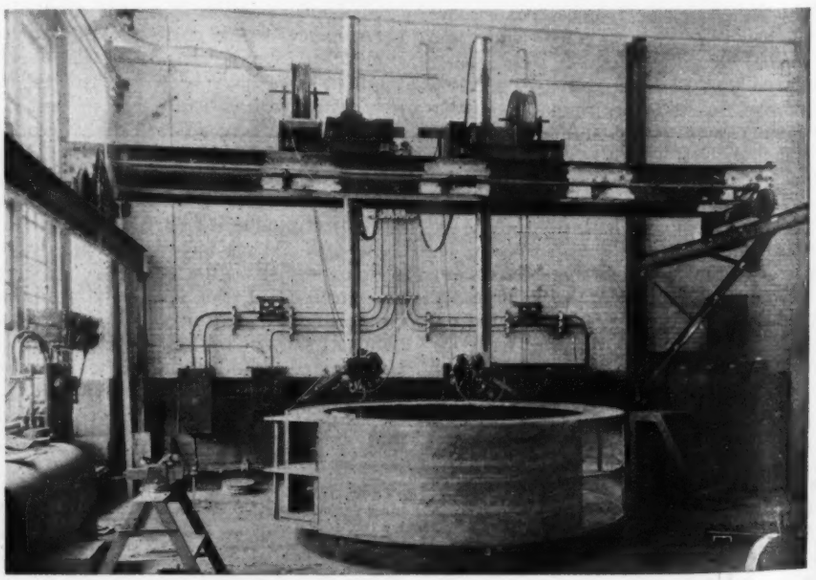
J. B. GREEN, Fusion Welding Corporation.

Surface materials have a significant influence on the brittleness or ductility of weld metal and can be used to control the type of arc developed They also affect the heating of electrodes and may be employed to control the operating characteristics of the electrode and the resultant weld properties. Among operating characteristics might be mentioned stability and rate of melting. Among the weld properties are included freedom from blowholes and tensile strength. Other practical applications of a comprehensive knowledge of surface materials are cited in this paper, which also deals with the fundamental theory of arc heat distribution, arc vapor resistance and similar characteristics modified by the presence of surface materials.

Arc-Welded Structures and Bridges

A. M. CANDY, Westinghouse Electric & Manufacturing Company

The advantages ascribed to arc welding follow: (1) The weight of materials required in a member or structure can be reduced by as much as 18 per cent; (2) no material is removed from members for welded connections such as rivet holes for riveted construction; (3) the weight of connecting material in some cases can be reduced 50 to 90 per cent; (4) absolute



STATOR-FRAME AUTOMATIC WELDER FOR FRAMES UP TO 14 FT. DIAMETER (WOOD)

fixation of one member to another can be readily obtained; (6) greater rigidity can be obtained in a structure; (7) overlapping members can be completely sealed by weld metal, thereby excluding moisture, preventing corrosion and making a structure easier to paint; (8) changes in or additions to structure can be made with a great saving in both time and expense; (9) more pleasing designs and in some cases designs impossible by other processes can be produced; (10) the welding process is practically noiseless.

TO ILLUSTRATE the character of arc phenomena and influence of welding materials Mr. Green presented a series of lantern slides and a slow-motion picture film secured by the use of infra-red sensitive negatives. Replying to questions by C. Siebenmorgen, J. C. Lincoln, A. P. Wood and A. M. Candy, Mr. Green explained that the electrodes were $\frac{3}{16}$-in. diameter, the currents about 125-150 amp. and that the different length paths assumed by the arcs were probably due to the relative and absolute resistances of the core and sheath characteristics. Hand welding was used in making the study, a constant potential source with large excess of ballast resistance being utilized. Flux is used in gas welding to dissolve the oxide, while for electric arc welding its purpose is to improve the arc-heat distribution. In his opinion arc and gas welding, in so far as quality of work is concerned, are interchangeably satisfactory.

An explanation of the fundamental idea of the atomic welding process was offered by Elihu Thomson in connection with Mr. Alexander's paper. Dr. Thomson pointed out that the concept of dissociation means that a molecule in absorbing energy under welding conditions is broken up into its atomic components, which reassociate with a release of energy.

In response to an inquiry by E. Herzog regarding the use of atomic ionizing-potentials, Mr. Alexander indicated that molecular values are unnecessary except for gases, as other materials listed do not exist in gaseous form except in the atomic state. He advised that ionizing-potentials referred to in his paper involve the energy that an electron should accumulate to energize a neutral atom. Replying to an inquiry by R. J. Kehl regarding a practical application of hydrogen shielded arc, Mr. Alexander reported that it is not sufficient merely to establish the fundamental principles involved in such a process, since the technique of handling must be advanced to a usable state.

A question of whether atomic welding could produce oxide-free welds was answered in the affirmative by the author, who also added that the resistance to corrosion of atomic-hydrogen welds had not as yet been fully established, but that higher corrosion-resistance values are anticipated.

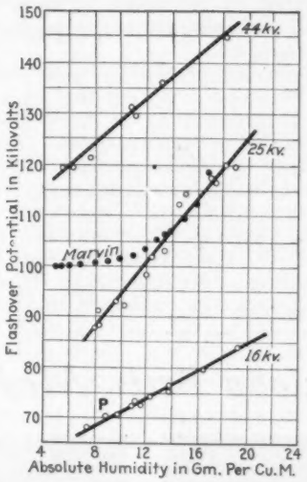
J. C. Lincoln demonstrated an electric torch in which two-thirds of the heat of the electric arc appeared in the flame. Herman Lamb and Dr. Thomson added data regarding similar devices known to them some years ago.

Miscellaneous

Effect of Humidity on Dry Flashover of Insulators

J. T. Littleton, Jr., and W. W. Shaver, Corning Glass Works

Humidity affects considerably the flashover voltages of porcelain and Pyrex insulators, the potential rising as the humidity is increased. This characteristic is a surface effect which varies with the absolute water content of the surrounding atmosphere. A decrease in flashover potential was noted at humidities above 90 per cent, but is believed to be due to condensation on the insulator surface, which could be avoided by having the insulator at the proper temperature. The curve slopes for porcelain insulators are slightly steeper than those for Pyrex insulators having approximately the same flashover potential. This may be accounted for by the high chemical resistivity surface of Pyrex insulators. A No. 441 Pyrex insulator at 760-mm. pressure and 35 deg. C. temperature would flash over at 128 kv. with a 10 per cent relative humidity and at 193 kv. with a 90 per cent relative humidity. Moreover, the apparent straight line relation between flashover potential and absolute humidity makes it possible to adopt a correction factor for the humidity effect on a given insulator and to catalog the dry flashover potential at a standard humidity as well as at a standard temperature and pressure.



VARIATION OF FLASHOVER POTENTIAL WITH HUMIDITY (LITTLETON AND SHAVER)

The curves apply to porcelain insulators, but very similar curves apply to Pyrex insulators.

Cathode Oscillograph in Study of Line Surges

Harold Norinder, Swedish State Power Organization

Investigations were reported covering the value of lightning arresters and other apparatus for protecting lines and equipment against surges, the fundamental nature of surges and the relation between natural lightning and laboratory lightning. The klydonograph was found to fail in many desirable requisites and serially modified. Specially constructed cathode-ray oscillographs were used. It was found particularly desirable to measure short-time intervals of the order of 10^{-6} to 10^{-8} seconds and to secure records of transients at exceedingly brief intervals during long periods of phenomena absence. The instrument employed should be of such relatively simple nature that it can be used by station mechanics or most operators, and the instrument should be in the recording position at all times. These requirements are met by the modified Dufour oscillograph.

The Saturation Permeameter

S. L. Gokhale, General Electric Company

A device for speedy and accurate measurement of the limiting value of intrinsic induction of magnetic material. The permeameter is of the bar-yoke type, capable of producing a magnetizing force of 4,500 gausses without excessive heating. A coil compensates automatically for the spatial flux inclosed by the potential coil, so that the ballistic deflections indicate the saturation value without any further computation or correction. The permeameter is suitable for all magnetic materials except cobalt and permanent magnet steels and will measure B or β with H as low as 200 gausses.

Compressed Powdered Permalloy—Manufacture and Properties

W. J. Shackelton, Bell Telephone Laboratories, and I. G. Barber, Western Electric Company.

The manufacture of magnetic cores of compressed permalloy powder and the electrophysical and magnetic properties, including permeability, core loss and modulation, are treated. The permalloy considered contains approximately 80 per cent of nickel. The technical problems involved in powdering the permalloy and in insulating the powder so that subsequent high-pressure forming and high-temperature heat-treating operations may be applied are related. The processes are said to be adaptable to economical large-scale production and at the same time to be controllable so as to insure a highly uniform product. Loading coils made with this magnetic material approximate one-fifth to one-third the size of former coils with no sacrifice in quality and with appreciable improvement in transmission efficiency, inductance stability and modulation.

RESPONDING to a question regarding his saturation permeameter, Mr. Gokhale explained that the method of clamping the specimen or degree of contact is not of primary importance in test work with this device and that the temperature rise during operation does not exceed 2.5 deg. C.

Mr. Shackelton pointed out that the use of permalloy-dust in place of iron-dust loading coils greatly reduces space requirements for manhole and duct-system installations and facilitates line design and construction.

B. Gherardi mentioned that the loading coil constituted not an incidental but an essential part of modern telephony, 3,000,000 being in use in this country, approximately one for every six telephone instruments, and that these devices are being added to the lines at the rate of 6,700,000 yearly.

In response to an inquiry from the floor, Mr. Barber, who read the joint paper, replied that so far as he knew no attempt had been made to apply permalloy to other than telephone

fields, due, he felt, to the relatively low permeability.

Discussing the paper on flashover potentials of insulators, E. D. Eby suggested that a correction factor is needed for rating and specifying different type insulators. While impulse flashovers are considered unaffected by wet or dry conditions, tests have shown that at 40 to 100 per cent relative humidity and 180 to 225-kv. crest voltages the highest flashovers occurred at 95 to 100 per cent relative humidity. The values did not go below those for wet flashovers on the specimens. Sustained periodic tests over several years indicated humidity and flashover voltages to be a maximum in August and a minimum during the month of January.

C. L. Clarke submitted the determinations of P. Woog with flashovers on glass cylinders as an explanation of the observed effect of increased flashover values with high humidity and suggested that it is not an air dielectric effect but a surface effect of the insulator that is involved.

C. F. Harding corroborated the statements regarding increases in flashover voltages with higher humidity values. Professor Harding pointed out the folly of referring insulator test data, secured under 60-cycle conditions, to a sphere-gap basis as flashover tests upon sphere gaps are not affected by humidity. Errors of 14 to 15 per cent may be involved in such comparisons.

Referring to Mr. Norinder's lecture, D. W. Roper reported that as a result of the dismantling of many pole-type distribution transformers rendered useless by lighting, scars had been found in all cases on only the secondary windings. Twenty to thirty such burnouts occur annually on the lines of the Commonwealth Edison Company. Although 300 to 400 domestic meters are connected to such secondaries no meter burn-outs are found. House services are carried through iron pipe, which is believed to protect the consumer's end of the circuits. In fifteen or twenty cases the wires have shorted to the pipe, but investigation indicated the presence of standing water in the pipe due to faulty erection practices. The possibility of protecting the transformer end of the service by the use of a ground pipe is being undertaken by means of cathode-ray oscillograph equipment.

K. B. McEachron mentioned the difficulty of automatically starting recording processes so they will respond quickly after a disturbance starts and suggested the use of a hot, instead of a cold, cathode ray oscillograph. The transient may be delayed slightly by passage through a cable section of known characteristics so that the surge reaches the oscillograph after the latter has attained full operating condition.

Edison and John Fritz Medals Awarded

WILLIAM DAVID COOLIDGE

JOHN JOSEPH CARTY

PRESENTED
AT THE
WINTER CONVENTION
OF THE
AMERICAN INSTITUTE
OF ELECTRICAL ENGINEERS
FEB. 15, 1928

"The Gold Medal has been awarded to ***William D. Coolidge*** *for his contributions to the incandescent electric lighting and the X-ray* ***arts by the American Institute of Electrical*** *Engineers."*

"The Medal for the year 1928 has been awarded to John Joseph Carty for pioneer achievement in telephone engineering and in the development of scientific research in the telephone art."

Symposium on

Energy Interchange

Experiences in Pennsylvania-New Jersey, Southeast, Chicago district and Pacific Coast interconnections related before A.I.E.E. convention

THE past four years has witnessed additional and higher capacity interconnections. Individual system operation has been improved, as has co-ordination between systems. More use is being made of interchange facilities. More careful forecasts of load growth and system planning are being conducted. Advantage is being taken of the lower costs of larger units and particularly of the efficiency of the modern steam-generating plants. Long-distance transmission is growing more reliable. But there are still many problems unsolved or only partially solved.

Load dispatching becomes more difficult and complicated with the growth of systems. Relaying continues to require much study. The division of load between parallel circuits, the control of wattless current, system stability and more reliable oil circuit breakers are problems worthy of the best engineering brains in the industry. As hydro-electric stations decrease in size, more automatic ones will be constructed to keep down the cost per kilowatt-hour. The future will probably see still larger steam plants with larger units located at the mine mouths, when water is available there, and others as near to large load centers as available condensing water will permit. These will, in turn, bring up the problems of still heavier trunk transmission lines. The last word has not yet been said regarding lightning protection. Improvement in communication circuits also offers a fertile field for study.

The foregoing statements, made by W. E. Mitchell, Georgia Power Company, and applied to the Southeastern section of the United States, indicate almost without exception the situation all over the country.

Accomplishments in the Southeastern States

By W. E. Mitchell
Georgia Power Company

TREMENDOUS strides have been made in the last few years to increase the capacity of the interconnecting links between different systems, to develop water power distant from the power market and to construct mine-mouth or other strategically located high-capacity steam plants, and to connect them with the great load centers by means of high-capacity networks. By co-ordinating various operating companies under holding companies, the benefits of massed capital, massed resources and unified control have been realized. Interconnection, group management, low-cost steam generation and long-distance transmission have come as a logical succession of natural economic steps.

Interconnection between independent systems is, first of all, a measure of protection in emergencies. But it cannot be a complete success unless the executives and operating forces of the respective companies realize it is a give-and-take proposition and have mutual regard for each other's obligation to the public.

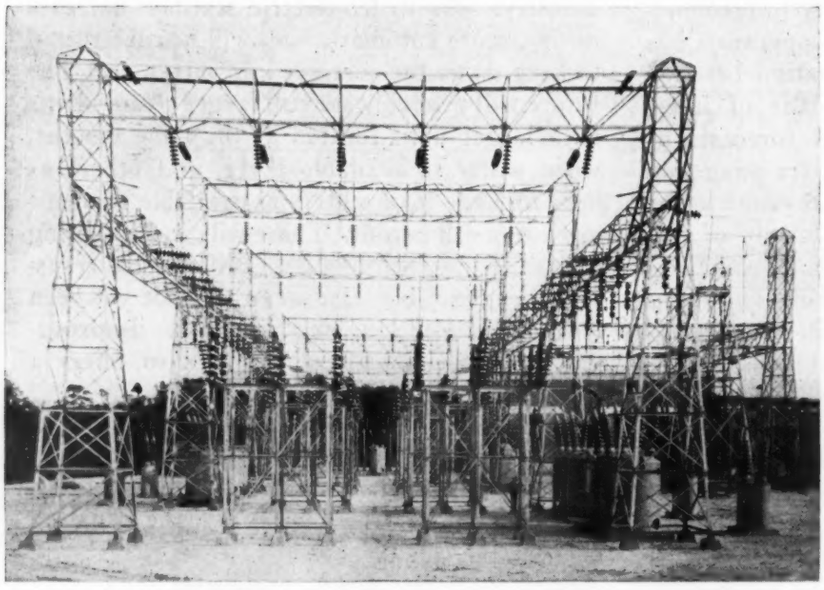
To stimulate the needed mutual interest the companies that are involved in the Southeastern interconnections have jointly formed an operating committee which meets about eight times a year and compares operating data, load, rainfall, storage reservoir conditions and problems of mutual interest. The resultant better understanding of each other's systems and their points of strength or weakness has facilitated the prompt handling of emergency power exchanges and improved operating economies.

Unquestionably great benefits can be derived from interconnections between independent companies or systems, but it is practically impossible for such companies to have a unified development program. If the companies are under the same financial, engineering and management control, then genuine system planning on a large scale will be practicable and the most economical plants and tie lines can be built first, because only the results for the group as a whole need be considered.

For successful parallel operation and to secure the proper load division between interconnected generating stations and systems, it is essential that the frequency be very closely controlled. This has been facilitated by the installation of master clocks at the larger generating stations and use of extremely accurate frequency recorders at load-dispatching centers. The system sup-

plying the bulk of the power regulates the frequency. Special attention has been given to the adjustment of governors at all generating stations, so they will respond as uniformly as possible and enable each station to carry its share of load fluctuations.

Voltage control grows more important and more complicated as larger systems are tied together and as additional interconnections are made. To minimize this problem synchronous condensers with a total rating of 130,000 kva. are used on the Southeastern Power & Light Company's system, being controlled by automatic voltage regulators. During the wet season, when steam units are not required for supplying power, generators are disconnected and operated as synchronous condensers. During peak-load hours, and when not required for supplying power, the hydro-electric units are used for power-



EAST POINT SUBSTATION, CONNECTING GEORGIA AND ALABAMA SYSTEMS

factor correction. Naturally such units are not as beneficial as synchronous condensers at load centers. However, they are generally at opposite ends of the system from the steam plants, so they serve to correct voltage.

It has not yet been found necessary to install regulating transformers in tie lines to govern the division of load and wattless current, but it is very likely that this or some other method will be required as the number of ties between the systems increases. With the increasing amount of load carried over the lines the problem of system stability has been encountered. Simultaneous readings of load, power factor, voltage, etc., have been found of considerable assistance in the system operation. In order to analyze troubles and provide remedies, permanent recording equipment, such as the Hall recorders, or oscillographs, are now being installed at strategic points on the system.

A great need exists for a system of relaying which, while selective, will instantly disconnect a faulty circuit. At present ordinary induction type overload relays are being used on single-circuit lines, a short time setting being provided to secure selective operation. In a few instances the settings of these relays have been such as to hold a short circuit on the system long enough to affect the system stability, and in one or two cases has resulted in rather serious interruptions. On the double-circuit tower lines balanced relays are functioning very satisfactorily. However, during lightning storms both circuits on the tower lines are frequently interrupted simultaneously.

The construction of some 154-kv. lines built recently brings out forcibly the economy of unified control. The lines considered permit the postponing of the construction of additional power plants by one company until those under way by other companies under the same control are loaded up.

As the systems grow larger interconnection between those under one management makes for greater operating efficiency, as full advantage can be taken of diversity of time, rainfall and seasonal load. Less benefits could be derived from these factors with ties between independent companies. With the large storage reservoirs practically no water goes to waste during the summer season. If one section has a heavy rain and another none the tie lines permit sale of the surplus at such a price that the company that has had no rain can afford to buy power and store its own water.

Run-of-river plants which formerly wasted water all night long because they had little or no storage now generate more kilowatt-hours because they are linked with a comprehensive system. By jointly studying the hydrographs of all rivers in the territory for the last 25 years and considering wet, dry, average and medium periods it is now possible to forecast available water fairly accurately a year in advance.

Operating and maintenance practice has also improved with the exchange of operating data and ideas, resulting in reduced maintenance expense and more efficient condition of equipment. Co-ordinated development and operation of plants has made it possible to develop more kilowatts of capacity per dollar of investment and to produce more kilowatt-hours at a lower cost than would be practical under independent management.

The improvement in steam-generating efficiencies, plant costs, the reliability of the large steam units and the varying character of Southern streams is making utility engineers in the South realize that a greater and greater proportion of power will be produced by steam in the future.

During 1927, as in 1925, the value of interconnection was emphatically demonstrated to the Southeast. Enabled by co-ordination of the systems and the tie lines water was conserved in the Burton storage all during the spring and drawn out in the late fall, when most needed. Under independent operation the tendency would have been to have taken a chance on getting summer rains (which never came), and so to have drawn upon the stored water that when the final pinch came there would have been none left. Then industries would have been forced to curtail because the tie lines could carry no more and the hydro plants would have been greatly reduced in capacity by lack of water.

Other striking examples of the benefits of interconnection were afforded the same year. A large cotton mill in Georgia had a failure in its isolated plant. Within 24 hours from the time notice was received the power

company had picked up more than 3,000 hp. of the mill's load and within 72 hours the entire 10,000 hp.

Again when the flow of the Savannah River dropped nearly as low as in 1925, a local plant near Augusta was inadequate to carry its load for several months and 15,000 to 20,000 kw. was supplied over the interconnecting 110-kv. line.

Another example of the greater use of available resources: Company A had available 25,000 kw. of transmission capacity but no surplus generating capacity. It was interconnected on one side of its system with Company B, which had surplus power, and on the other side with Company C, which was short of power. Transmission facilities were leased from Company A, power purchased from Company B, and Company C's needs completely cared for.

The effect of interconnection on steam-generating plants is illustrated by consideration of one in Alabama. Whereas eleven years ago the first large unit installed at Gorgas was 25,000 kva., and the plant was built purely as a reserve steam plant to operate at from 10 to 25 per cent annual load factor, the new plant will be a base-load plant operating on a 50 per cent annual load factor at first and probably ultimately on a 70 per cent load factor. Another interesting fact is that while the new plant will be 50 per cent more efficient than the old, its cost per kilowatt will be but little, if any, higher; such is the effect of larger units. Again, units of 66,667 kva., which are used in the new plant, would not be the proper size were there not ample reliable tie lines between Alabama and Georgia so that such a unit would be available to both companies.

Transmission lines still constitute the weakest link in the chain between generating station and customer. After fifteen to twenty years' experience Southern operators feel sure that ground wires are justified on important lines. The new 154-kv. lines being built in Alabama and Georgia are being overinsulated, but the equipment is not. For its protection, a weak link will be put in the lines near the substations by leaving off two or three of the insulator disks. On the Southeastern Power & Light Company's system we feel that in the more important stations lightning arresters should be installed. Annual buzz-stick testing is favored for eliminating defective insulators and lines are patrolled after every interruption.

With the growth and interconnection of systems the necessity of uninterrupted communication circuits has grown in importance. Important stations and load-dispatching centers are usually coupled by several private land-line circuits as well as by Bell system lines. Extensive use has been made of the carrier-current telephone system with exceptionally good results. It is being used regularly for load dispatching over 1,000 miles of transmission lines.

Oil circuit breakers continue to be one of the most important factors affecting satisfactory long-distance transmission and system interconnection. Here again the increase in capacity of transmission lines and the concentration of power necessitate ever-increasing capacity in the oil circuit breaker. Today short circuits of 1,000,000 kva. are possible in the Birmingham district. We believe we shall continue to give best service by operating with so-called solid ties as compared to the loose-link method, limiting short circuits by opening the ties at certain predetermined points. Later we shall probably add 110-kv. reactors through which no current flows normally.

Interchange Arrangements in Chicago District

By H. B. Gear
Commonwealth Edison Company

MAXIMUM use of reserve generating capacity and low-cost energy is facilitated in the Chicago district by the provisions of a three-party energy-interchange agreement. This pools reserve capacity and permits the flow of energy to neighboring zones whenever the load in the immediate zone permits or when the energy so transferred costs less than that produced in the neighboring zone.

The difference between the total capacity in the pool

AT POWERTON, CLOSE TO THE COAL FIELDS, A BASE-LOAD GENERATING STATION IS BEING CONSTRUCTED

and the coincident maximum load of the three systems is taken as the group reserve, until a higher maximum has been established or additional capacity put into service.

The percentage of group reserve is taken as the standard and any company having a reserve percentage higher than the group percentage is compensated for the carrying charges on its excess station capacity by the other company or companies whose percentage of reserve is less than that of the group. This permits the smaller companies to install larger units than would be possible if only the requirements of their individual systems were to be met, and thus gives them capacity for future growth at a lower investment cost, with higher operating efficiency.

Operation on this basis is not accomplished at the expense of the larger companies, except temporarily, as they are able to draw upon the excess capacity thus created and so defer, for a year or more, additions to their own plants.

Power-station construction for the entire district is co-ordinated through a committee of two representatives from each company. It studies load increases in the

various zones and recommends to the executives the size and location of units to be added from year to year. The recommendations are made about two years in advance of the dates when the units are to come into service.

Reporting to this committee is a sub-committee of load dispatchers, which meets weekly to arrange operating schedules for the transfer of energy from the more efficient stations to other zones during off-peak periods, to co-ordinate removal of turbines for overhauling purposes and, in emergencies, to confer by telephone and arrange relief where it may be required.

The conditions which existed during one of the summer months of 1927 illustrate the way in which the energy-interchange agreement is accomplishing the result contemplated by the parties thereto:

SYSTEM CONDITIONS DURING A SUMMER MONTH IN 1927

Company	A	B	C	Total Kilowatts
System maximum.....	864,300	139,800	44,700	1,041,000
Reserve capacity, kw....	101,245	97,980	2,075	201,300
Reserve quota (19 per cent)	165,875	26,240	8,585	201,300
Excess and *deficiencies..	*64,630	71,740	*6,510	.....

Company "A" paid Company "B" for 64,630 kw. of reserve capacity and Company "C" paid Company "B" for 6,510 kw. of reserve capacity. Thus Company "B" was reimbursed for an excess of 71,740 kw. in its reserve capacity. During the same month Company "A" delivered to Company "B" 9,135,000 kw.-hr., Company "B" delivered to Company "A" (in other zones) 16,936,000 kw.-hr. and Company "A" delivered to Company "C" 9,172,000 kw.-hr. Of the total of 35,243,000 kw.-hr. thus transferred, about 19,000,000 kw.-hr. were delivered during off-peak, resulting in a fuel saving of about $19,000 in that month.

Normally the three systems are operated in parallel with each other and with the Twin Branch station at South Bend most of the time. Parallel operation with the Milwaukee system is not normal, as this line is maintained, primarily, as a reserve connection for use in emergencies. Interconnections with companies west and south of the Chicago district are also operated, for the most part, as reserve connections and are paralleled only as operating conditions require it. These lines are of small capacity and are not suitable for other than local reserve service.

The interconnection of power stations by lines of relatively large capacity has resulted as follows:

(a) The size of generating units is increased, while the total capacity and reserve for a district is decreased.

(b) The investment per kilowatt of capacity in generating stations and the total investment are decreased.

(c) The consumption of fuel is reduced by ability to give the more economical units the "base load" of an entire district.

(d) The reliability of service is enhanced by increased availability of the capacity and reserve in generating units during emergencies and routine operating work, such as overhauling and repairing equipment.

Some problems require solution before an interconnected group may realize the advantages sought. These problems relate, chiefly, to the ability to control the division of energy between neighboring stations and to make delivery continuously when occasion requires. Experience thus far in the Chicago district indicates that these problems lie outside of the generating equipment almost entirely and relate to the size, voltage, length and other characteristics of the interconnecting lines.

When line capacity is high and lengths are short in proportion to the voltage of transmission the transfer of energy between stations is readily accomplished by governor control of the generating units. When lines are relatively long and have a capacity which is approached by the normal surges of synchronizing energy, which flow between the two sources of power, there is instability of operation, and lack of continuity is likely to result.

The presence of several successive transformations in a tie line has the effect of increasing its impedance and is, thus, equivalent to an increase in length. More than two transformations (one each way) are to be avoided in such lines, if possible.

With long lines or lines in which the direction of flow of energy is at different times in opposite directions it is often necessary that means of voltage control be provided. These are required to permit the receiving station to operate its bus at a voltage level suited to the requirements of the circuits supplying energy within its own area of distribution. In such situations transformers with tap changers, adjustable under load, are finding useful application.

At the higher voltages the use of synchronous condensers for voltage control are often found desirable through the ability to regulate the power factor of the system secured thereby.

Pennsylvania-New Jersey Interconnection

By the Late W. C. L. Eglin
Philadelphia Electric Company

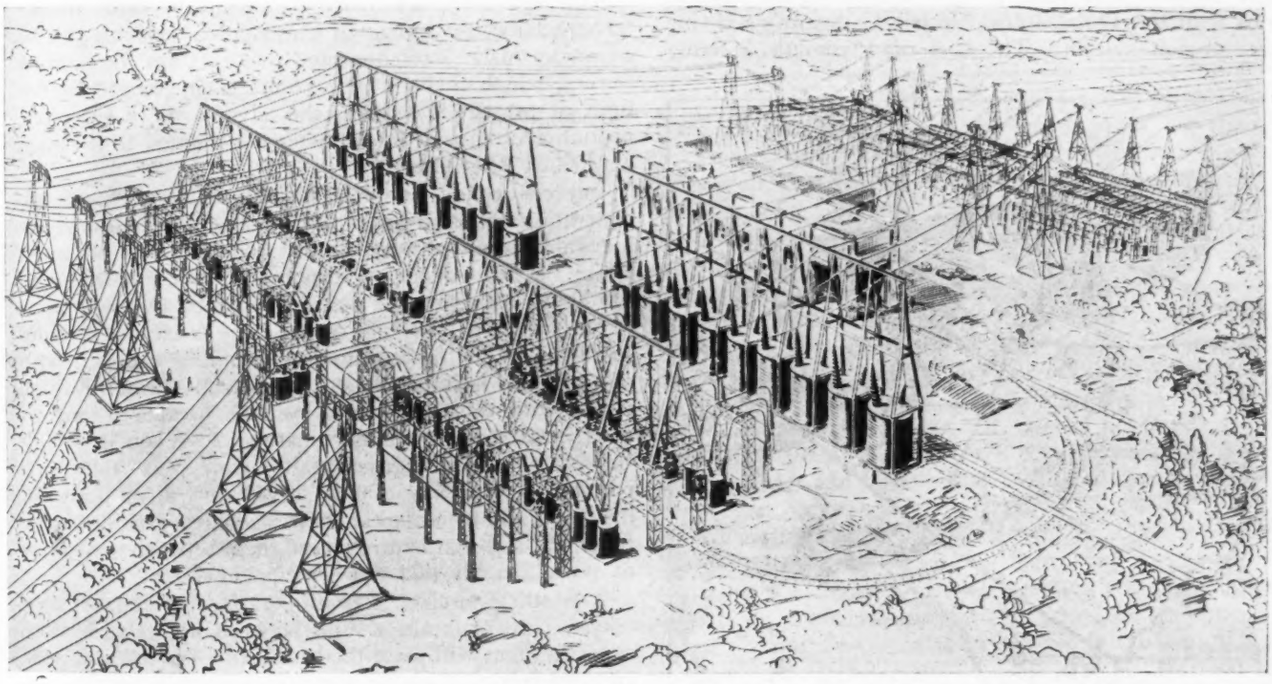
INTERCONNECTION ranges from ties of very small capacity between outlying points of adjoining or interpenetrating systems, which if utilized to the utmost could not materially affect the operating economies of the system taken as a whole, up to trunk lines connecting principal centers of load and generation, involving a comprehensive mutual program with large investment and promising commensurate return. To the latter class belongs the interconnection between the Philadelphia Electric Company, the Pennsylvania Power & Light Company and the Public Service Electric & Gas Company, the first step of which is now practically ready for operation. It is the purpose of the three companies by this interconnection so to co-ordinate their construction and operation programs as to result in a maximum saving of investment and operating expense. The studies made preliminary to the final agreement indicate that the present contemplated construction, namely, a complete 220-kv. ring between the systems with suitable facilities for connecting each system to the ring, will, when carefully operated, utilize to the best advantage all of the diversity occurring between the system loads for the coming ten years.

Each company will design and construct the lines lying within its own operating territory, although all three have agreed upon the climatic loading conditions and the general basis of design.

The principal saving in this case results from load diversity, in that the peak load of the combined systems is smaller than the sum of the individual peaks. By

pooling the reserve capacities which the companies maintain they are able to dispense with a certain portion of this reserve without loss of reliability. Staggering of construction among the companies will make the installation of two or three generating units adequate in any particular year, where four or five might be required if the three systems operated independently. Distribution of the combined load so that the more efficient stations will carry the base load and the less efficient the peak loads will be a source of considerable saving in operating expenses. The furnishing of emergency power in excess of normal reserve requirements when this is available in the other companies results in no actual money saving, but does improve reliability of operation.

Load Diversity—In this interconnection the principal portion of the load diversity is due to the difference in the shape of the individual daily load curves on any selected day during the peak period of the combined



Substation connecting Conowingo and Philadelphia System with Pennsylvania Power & Light and Public Service Electric & Gas Companies

Plymouth Meeting substation, which will be the junction point for the 220-kv. lines from Conowingo, the 220-kv. loop connecting the three companies and the 66-kv. lines to Philadelphia will be equipped with three 30,000-kva. synchronous condensers initially. Self-cooled 220/66/13.3-kv., 100,000-kva. transformer banks equipped for ratio changing (15 per cent range) under load are installed. Air-jet radiator cooling will increase their rating to 130,000 kva. The condensers are connected to the 13.3-kv. tertiary windings and are equipped with extra high-speed excitation. Many unusual features of design are involved.

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systems. Further contributions are made by the difference in the season of annual peak and by the noncoincidence of those accidental high days which cause weekly or monthly peaks on the individual system. For example, the daily peak of the Pennsylvania Power & Light Company is in the morning throughout the year, with the afternoon load slightly lower and the evening load materially reduced. The annual peak load occurs in October. The load curves of the Public Service Electric & Gas Company and the Philadelphia Electric Company are quite similar, both having large evening loads throughout the year, and in particular a high peak near 5 p.m. throughout the winter months. The yearly maximum load of both usually occurs in December.

Reserve Diversity—The experience of the three individual systems with calls upon their own reserve generating capacity indicates that these are relatively infrequent and no loss in reliability is expected under the assumption that the interconnecting companies will not all require their share of the total reserve diversity simultaneously.

Economic Distribution of Combined System Load—In a single system of steam-generating stations, especially when serving a compact territory, the proper apportionment of load among stations seldom offers serious difficulties. It is usually found economical, as the system grows, to build up one station at a time from initial to ultimate capacity rather than to have two or more under way simultaneously. Thus each station in its operating performance reflects current practice during its design and construction period, and the cost margin between stations is sufficient to render the correct distribution of load obvious. Transmission limitations and minimum loading requirements of stations may enforce departures from this ideal distribution. In the case of a system of wide area and low concentration of load it may prove more economical to establish two or more centers of supply, and increase them in capacity according to the requirements of their districts, rather than to provide the transmission facilities required to permit all the growth to take place at one station.

No matter to which class the systems concerned belong, the interconnection of two or more systems which have grown up entirely independent, and which are therefore likely to include stations of approximately equal operating performance, offers many delicate problems of load apportionment.

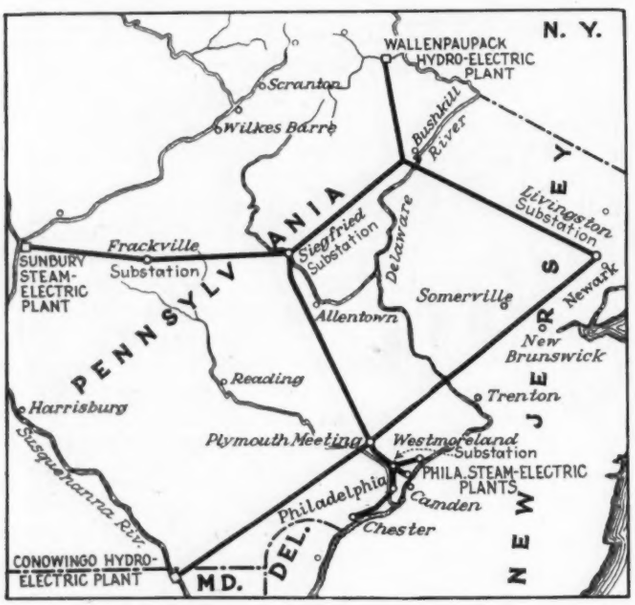
Load Dispatching—The interconnection headquarters for general administration and load dispatching is to be established at Siegfried. It will be advised of the ex-

pected outputs from the various hydro plants of the system as far in advance as estimates can reasonably be made, and will plan the operation of the steam stations to carry most economically the remaining load. The preliminary studies of the interconnection project have demonstrated conclusively that an opportunity for large savings exists, but only the most alert and skilled load dispatching will realize all of the possible benefits.

Relay protection on the 220-kv. lines consists essentially of special type C Z relays and directional, ground-current relays. Transformer banks and condensers have the usual differential protection. The 66-kv. lines are also protected by C Z and ground-current relays.

The 220-kv. oil circuit breakers have an interrupting capacity rating of 2,500,000 kva. and the 66-kv. line breakers a rating of 2,000,000 kva.

The Conowingo and interconnection projects have many favorable reactions upon each other. One of these is the common use of facilities for connecting the 220-kw. lines with the Philadelphia Electric Company's existing transmission system. The cost of Plymouth Meeting



THREE LARGE SYSTEMS POOL THEIR SERVICE FACILITIES THROUGH THE MEDIUM OF THIS LOOP

substation and of Westmoreland substation (66-kv. tie between Plymouth Meeting substation and Philadelphia), for either the Conowingo project or the interconnection separately would have been considerably greater than the proportionate share of the actual combined construction cost. Furthermore, a high-capacity, initial installation was imperative at Conowingo on account of the size of the dam. This precluded independent operation and building up of local load or transmission to existing load centers with provision of expensive steam-generating reserve for use in the low-flow periods.

That the project has now become economically justified is because the Philadelphia Electric Company system load is large enough to absorb nearly the entire output of the plant at all times, while operation in connection with the existing steam stations in Philadelphia, utilizing Conowingo station as the base of the load in high flows and on the peak in low, makes relay steam capacity unnecessary.

The output of the Conowingo project can be completely absorbed earlier with the interconnection, since the minimum combined load of the three systems is well above the full load capacity of Conowingo station. Likewise, Conowingo's value in replacement of steam-generating capacity at all times of the year is greater with the interconnection.

Pacific Coast Observations

By P. M. Downing
Pacific Gas & Electric Company

THERE are many instances where two or more independent systems are operating very successfully under interconnection agreements, but to obtain maximum benefits, control and management should be unified.

Although there are many arguments in favor of interconnection, the extent to which power systems can be advantageously interconnected has certain limitations beyond which there is no advantage in going. In the light of present knowledge the advantages of interconnection are regional in character and limited to a radius of 300 to 400 miles.

Interconnection between various sources of electric generation and distribution on the Pacific Coast was the inevitable result of environment and economic pressure. Along the route of these transmission lines, running from the hydro plants on the western slope of the mountains to the larger cities along or near the coast, were many small towns and agricultural communities supplied with power from isolated plants. Eventually most of these plants with the distributing systems became a part of a larger and more extensive network. When it is considered that the agricultural business is the least remunerative of any that is served, it will be apparent that the rural communities have benefited greatly by the fortunate fact that nature placed them between the source of power supply and the principal markets.

It is still desirable, if best operating results are to be obtained, to maintain a ratio between hydro and steam capacities that will place the base load on hydro and peak and emergency loads on steam. The ideal relationship depends upon such elements as load factor, relative capital costs of steam and hydro installations, cost of fuel, etc.

From the standpoint of continuity of service, steam plants play a less important part today than they did a few years ago. For example, the Pacific Gas & Electric Company, with a peak load of 439,568 kw. and an energy output of 2,380,000,000 kw.-hr., produced less than 0.9 per cent of it by steam. Several factors have contributed toward bringing about this change. In the first place, as the number of hydro plants feeding into an interconnected network is increased, temporary cessation of operation of one or more generating stations whose output represents a comparatively small percentage of the total has but little effect on the general service of the system as a whole. A similar situation obtains in the case of transmission lines. However, a much more important factor in improving service, in so far as transmission is concerned, is due to the better quality and design of insulators that are now available and the better and more substantial physical construction used.

Some of the chief factors that must be given consideration in the operation of interconnected systems are:

Important Benefits from Interconnection

1. Greater reliability of service and increased economies. In cases of a shortage of power due to accidents to equipment, other similar devices on the interconnected system can supply the shortage until repairs are made or other units put into service. Under normal conditions, the more efficient units can be operated, the less efficient being held in reserve and operated only in emergencies.

2. Increased diversity, thus reducing the power requirements of the combined systems and, by improving the load factor, reducing the capital investment in plant facilities.

3. Common use of reserve or spare capacity, further reducing the capital investment in plant.

4. In cases where the network is supplied with power from both steam and hydro sources, the hydro stations can be operated continuously at full load when water is available, thus making a maximum beneficial use of water power and a minimum use of steam. On a smaller system there would be much less opportunity of doing so.

5. General availability of power over large areas, thus making it possible for factories to locate where raw material, labor, market conditions, etc., are most favorable. This is particularly important as it permits manufacturing plants to locate in smaller towns and agricultural areas and use labor normally employed during certain seasons only. In this way interconnection becomes an active force in the decentralization of population.

P. M. DOWNING,
Vice-president Pacific Gas & Electric Company.

1. Dependable communication.
2. Centralized authority and control over operations.
3. Location and isolation of trouble.
4. Voltage regulation and control over the entire network.
5. Frequency control.

When trouble occurs on the power circuits the inductive disturbances are generally sufficient to make communication circuits on the same or closely adjacent structures inoperative when they are most needed. Much more dependable communication can be had over circuits independent of and located a sufficient distance from the power line to be out of range of inductive interferences. Recent developments in carrier-current equipment give promise of providing a cheaper and more dependable means of communication.

The success attending the operation of large interconnected networks is due in very large measure to the fact that authority and control over the details of operation are centralized in the load dispatcher. Among the more important responsibilities of this position is allocation of load among the generating stations, substations and lines in such a way that there is maximum use of the more efficient plants or equipment, conservation of water or fuel and readiness to meet any operating emergency. Under normal operations, these conditions can be met without any great difficulty, but once the regular operating routine is upset by storms, breakdowns, water shortage or otherwise, the resourcefulness of the load dispatcher may be taxed to the limit.

Where generating stations and switching centers are separated by several hundred miles there is always the liability of partial or complete failure of the communication circuits. To dispatch orders under this condition increased accuracy and saving of time have been effected by use of code numbers indicating prearranged instructions.

Localization and isolation of trouble have been greatly facilitated by substitution of relay-control for manual operation of switches.

As an interconnected network grows and the amount of power delivered into it increases, the necessity of having dependable switches becomes of increasing importance. The construction of high-voltage switches has been materially improved during recent years, but there has been practically no change in the general design. Failure to keep pace with the development of other facilities used in connection with the production and transmission of high voltages has made them the weakest link in a power system.

Thus far the vacuum type switch has given more promise of relief than any other that has been proposed. Laboratory tests have shown that there is practically no deterioration or damage to the contacts after opening a 15,000-volt circuit carrying 120 amp. more than 500 times. If this type of switch can be developed to a point where it can be used on a commercial basis there is every reason to believe that it will rapidly supersede the present oil type.

Condenser installations can be fully justified not only as a most satisfactory means of improving voltage regulation but they also have a tremendous economic value in that, by improving the power factor, the amount of power that can be carried over a given line is materially increased.

Frequently control on an interconnected system is a comparatively simple matter. Irrespective of the number, size or location of generating stations one station does the governing. Ordinarily the station near the load center, where a sufficient governing margin can be maintained at minimum cost, is selected. Where a hydro plant does the governing it is desirable that one having sufficient forebay capacity to supply the varying drafts necessary to meet load fluctuations be selected. Where the network is supplied from both hydro and steam sources, especially where the latter is operated as a standby or reserve source of power supply, there is but little, if any, economy in governing with steam. Maximum economy will be obtained by loading all hydro plants except the one doing the governing, thus reducing the steam load to a minimum and keeping only enough boilers hot to pick up the predetermined amount of load that is to be thus protected against interruptions in case trouble should occur.

To prevent seesawing of load between different plants the governors on the governing plant are adjusted sensitive enough to operate on a minimum variation in speed. Those on the other plants are adjusted to operate only

on the wider variations that would occur if and when for any reason they might become separated from the governing station.

On a reasonably large interconnected network of lines, carrying a highly diversified load, the instantaneous variation in load, or what is ordinarily called the governing margin, is comparatively small. In fact, it is not at all unusual during short water periods to reduce this to practically zero and follow the gradual variations in load by hand control. On the system of the Pacific Gas & Electric Company, with a peak of almost 440,000 kw.-hr. supplied to an area larger than any other interconnected network in the West, the normal governing margin is between 1,000 and 2,000 kw.

System Voltage Control

By C. P. Hubbard
System Operator Detroit Edison Company, Detroit, Mich.

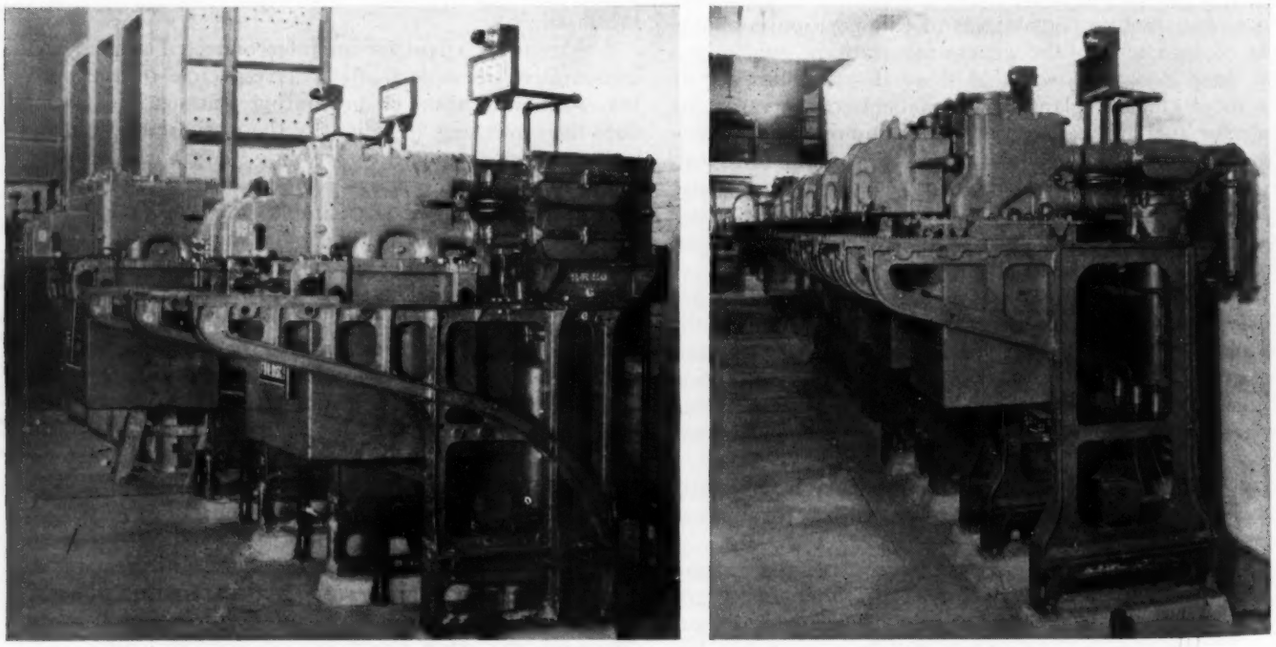
CONTROL of voltage on the Detroit Edison system from the generator busbars to customers' outlets is the direct responsibility of one man in the engineering division of the electrical operating department. Load conditions are not permitted to affect the voltages; that is to say, over- or under-voltage is not allowed at times of light or heavy system load. Except for a slight variation, caused by shifting wattless current from one plant to another, the generating-plant voltages are carried practically constant throughout the 24 hours of the day. Generator voltage is not regulated to compensate for system conditions caused by changes in load. The voltage schedules in the various elements of the system are maintained by tap chargers at switching stations and by synchronous condensers at the ends of long transmission lines. It should be observed that these synchronous condensers are more for voltage control than power-factor correction. The synchronous condensers are not operated at scheduled loads, but are controlled by the local station operator in accordance with voltage conditions at the particular point. The operator increases or decreases load on the condenser, or even removes the unit from the line or replaces it on the line entirely as the local voltage conditions warrant.

System voltages are checked both by voltage charts and by periodical testing. Bus voltages at generating stations are taken every half hour. Bus voltages at large switching stations are watched carefully and any deviation from normal is reported to the system operator at once. At attended substations a complete set of voltage and load readings are taken on three days each week, at 10 o'clock in the morning and during the evening peak load. These regular readings are supplemented with voltmeter charts taken at unattended points on the system.

It is the duty of the man in charge of voltage control to determine which taps are to be used on regulating transformers at the switching stations and to determine when these taps shall be changed by reason of changes in load. The usual range of the taps is in steps of 2½ per cent to 10 per cent above and below normal. The voltage on the transmission lines is kept as nearly constant as possible. Distribution voltage regulation is accomplished by regulators installed either on individual lines or on transformers feeding distribution buses. It is intended that these regulators shall care for all distribution voltage conditions and no attempt is made to regulate these conditions by changes of the transmission line voltage.

Iron-Clad Equipment Saves Space in New Substation

REYROLLE switchgear is used throughout the new East 172d Street substation of the New York Edison Company. Energy is received at 13,200 volts, three-phase, and transmitted at the same potential to outgoing feeders, which in turn supply distribution transformers feeding low-voltage networks at strategic centers. Each incoming feeder is equipped with 330-kva. induction-voltage regulators and supplies three smaller distribution feeders.



SWITCHGEAR USED FOR INCOMING AND OUTGOING FEEDERS IS OF IRONCLAD TYPE

Lightning Experience*

Performance of different sections of 132-kv. line reduced to a common basis. Changes in tower design. Work done to reduce lightning troubles at stations. Efficacy of ground wire

By Philip Sporn
Electrical Engineer American Gas & Electric Company

WHEN a line goes out of service it is the business of the operating man to get it into service with as little delay as possible and afterward try to determine, if possible, what has happened. When the excitement of the emergency has passed this often results in a lack of evidence that will withstand critical analysis or give any real information as to what has happened such as would be of real benefit to future design. Keeping this in mind it is easier to understand why some of the records presented are in some respects incomplete. Examining the accompanying table it will be noted that the largest number of lightning outages occurred on the Twin Branch-Lima line. This line was in service for the full year and has a length of 128½ miles. Based on 100 miles of circuit, however, it is not at all out of line and checks up with similar performance on the Lima-Fostoria line and on the Philo-Crooksville line. On the basis of 100 line-miles the largest number of interruptions occurred on the Glen-Lyn-Roanoke line, but this figure is of course subject to the weakness that the line was in service for six months only, and there is no way of checking up whether the ratio employed for figuring the yearly number of interruptions was correct for the entire year.

Where Greatest Interruptions Occurred

Of the lines that were in service for an entire year the largest number of interruptions per 100 miles of line was sustained by the Logan-Turner line. This is a line that has no ground wires and, in addition, passes through especially rugged country. The length of the insulator string on this line is particularly short (see tabulated values) being, in fact, shorter than that of any other line with the exception of the Windsor-Canton line. Expressed in circuit-miles, however, the record is rather good. In such cases involving a double-circuit line, however, the method of dividing the total number of interruptions by two and calling that the interruptions per circuit is questionable. It raises the question whether such a result can be compared with the number of flashovers on a single-circuit line.

To amplify: Consider the two top wires of a double-circuit tower line with both circuits subject to the same potential gradient. Upon the occurrence of a lightning discharge, chance will usually determine which one of the two circuits is to flash over first. This assumes, of course, that their arrangement is perfectly symmetrical and that they constitute the same phase wire in their respective circuits. A flashover having occurred on one of them, the question arises whether that flashover does not reduce the energy in the surface sufficiently to lower the head of the wave to such an extent that the second wire will not flash over. The fact that among all the double-circuit lines the maximum number of instances in which both circuits flashed over on any one line was only four against a total number of flashovers of twenty would certainly tend to indicate that some such explanation may be the correct one.

The Roanoke-Reusens line is third in the number of interruptions per 100 miles of line, but the figure for a whole year was again obtained by a ratio and is open to the same objection as the figures for the Glen Lyn-Roanoke lines. The Philo-Canton and the Windsor-Canton lines, in spite of the fact that the Philo-Canton line generally is exposed to more severe storms than the Windsor-Canton line, have practically the same record for the year 1926, when reduced to a 100-mile basis One of these lines, namely, the Windsor-Canton line, has two ground wires and is considerably lower than the Philo-Canton line, which has only one ground wire. The record during 1926 would seem to show that from the standpoint of reliability the Philo-Canton line, even though it has only one ground wire, has been put on a plane of reliability equal to that of the Windsor-Canton line. From the data gathered on the Glen-Lyn-Reusens line and Roanoke-Reusens line in 1926 it would seem that the ground wire on these lines was not so effective as it was on the other lines. The ground wire construction being in general the same on all of the lines, a possible explanation for the large number of flashovers may lie in the fact that the tower resistance over the lines as a whole is rather high.

Apparent But Not Actual Immunity

An interesting line in the series is the Logan-Sprigg line. This line, of wood-pole construction, was originally built for 88,000 volts and was operated for a period of about five years at 44,000 volts. At the end of this time additional insulation was added and the line was cut over to 132,000-volt operation. The majority of the structures are two-pole A frames with ungrounded steel crossarms. The insulation is unusually liberal. For a while, when the line was first placed in operation, the operating records seemed to indicate an almost lightning-proof line, but detailed investigation has shown that this was not quite so. Considering the shortness of the line, namely 21 miles, the record is not particularly good, although again the record is open to the criticism that a full year's data were not available.

Only in one case has a line been out of service due to

**Excerpts from paper presented before A.I.E.E. at midwinter convention on Feb. 17.*

Operating Record and Some Characteristics of 132-Kv. Lines—(American Gas & Electric Company)

Line designation	Glen Lyn Roanoke	Glen Lyn Switchback	Lima Fostoria	Lima Twin Branch	Logan Sprigg	Philo Canton	Philo Crooksville	Philo Turner	Roanoke Danville	Roanoke Reusens	Ruthand So. Point	Saltville Kingsport	Switchback Logan	Switchback Saltville	Turner Logan	Tw. Branch So. Bend	Windsor Canton	So. Bend New Carlisle
Outages (one circuit only)																		
Due to lightning—1926	16	.....	9	23	3	13	3	11	0	13	3	.....	.....	.....	16	0	9	0†
Circuit outages due to lightning—1926	20	.....	9	23	3	15	3	11	0	13	3	.....	.....	.....	18	0	11	0†
Circuit outages per 100 miles of line per year—1926	48*	.....	19.8	17.9	31*	20.5	19.5	10.6*	0	36.6*	6.3*	.....	.....	.....	44.8	0	20	0†
Circuit outages per 100 miles of circuit per year—1926	24*	.....	19.8	17.9	31*	10.3	19.5	10.6*	0	36.6*	6.3*	.....	.....	.....	22.4	0	10	0†
Length of line—(miles)	65.0	30.0	45.6	128.5	21.0	73.0	15.4	118.7	65.0	43.0	50.3	56.0	50.0	46.0	40.2	4.9	55.0	17.7
Number of circuits	2	2	1	1	1	2	1	1	1	1	1	1	2	1	2	2	2	1
Number of ground wires	1	1	1	1	None	1	1	1	1	1	1	1	1	1	None	1	2	1
Date ground wire installed	6/13/26	8/13/27	5/15/26	6/7/26	None	5/6/26	4/9/26	4/22/26	9/16/26	5/5/26	3/15/26	8/25/27	.....	10/16/27	None	6/8/26	9/—/17	6/24/26
Line configuration (horizontal-vertical)	V	V	V	V	H	V	V	V	V	V	V	V	V	V	V	V	V	V
Protection—Rings and horns	No	Yes	No	Yes	No	Yes	No	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No
Protection—Horns line side	Some	.....	Some	.....	.....	.....	.....	Yes	Some	.....	.....	.....	.....	.....	.....	.....	Some	Some
Protection—Horns ground side	Some	Yes	Some	Yes	.....	Yes	.....	.....	Some	Yes	.....	Yes	Yes	Yes	Yes	Yes	Few	Some
Nature of terrain	Rolling to mountainous	Very mountainous	Very flat	Very flat	Very mountainous	Rolling	Rolling	Rolling to mountainous	Rolling	Rolling	Rolling	Rolling to mountainous	Very mountainous	Very Mountainous	Very mountainous	Very flat	Rolling	Flat
Length of suspension insulator string (inches) top	52.25	56.38	57.0	57.5	64.4	52.25	57.0	57.0	56.38	57.0	57.0	51.3	51.3	51.3	47.5	57.5	47.5	57.5
Middle	52.25	56.38	57.0	57.5	64.4	52.25	57.0	57.0	56.38	57.0	57.0	51.3	51.3	51.3	47.5	57.5	47.5	57.5
Bottom	47.50	51.3	47.5	51.75	64.4	47.50	47.5	47.5	51.3	47.5	47.5	51.3	51.3	51.3	47.5	51.75	47.5	51.75
Height of standard tower (ground to top crossarm) (ft.)	90	92	90	90	35–40	90	90	90	90	90	90	90½	92	90½	90-45(c)	90	74	90
Conductor spacing (vertical) (ft.) Top—Middle	13	15	13	13	.....	13	13	13	13	13	13	13½	15	13½	13	13	12	13
Middle—Bottom	13	15	13	13	.....	13	13	13	13	13	13	13	13	13	13	13	12	13
Clearance—Line to tower (normal position)—Top	6.0	6.5	5.75	5.75	7.0(a)	6.0	5.75	5.75	5.0	5.75	5.75	5.0	7.0	5.0	5.0	5.75	5.25	5.75
At suspension strings (ft.)—Middle	6.5	6.5	6.25	6.25	5.0	6.5	6.25	6.25	6.5	6.25	6.25	6.75	7.0	6.75	7.25	6.25	9.0	6.25
Bottom	7.5	10.0	7.5	7.5	7.0(a)	7.5	7.5	7.5	9.75	9.25	7.5	9.0	10.0	9.0	7.5	7.5	7.75	7.5
Clearance—Line to tower—(45 deg. position)—Top	4.8	5.0	5.0	5.0	3.25(b)	4.8	5.0	5.0	4.8	5.0	5.0	4.0	4.0	4.0	3.75	5.0	3.25	5.0
At suspension strings (ft.)—Middle	5.0	5.0	5.0	5.0	.....	4.8	5.0	5.0	4.8	5.0	5.0	4.0	4.0	4.0	3.75	5.0	3.25	5.0
Bottom	3.75	4.0	3.75	3.75	3.25(b)	3.75	3.75	3.75	4.0	3.75	3.75	4.0	4.0	4.0	3.75	3.75	3.25	3.75

(a) Side cond. to pole. (b) To wood pole. 4.0 deg. to crossarm. (c) "E" towers. * Corrected for one calendar year. † Record incomplete.

lightning trouble on it for a period in excess of the time necessary to close the line back in service. The one case referred to occurred on May 18 on the Windsor-Canton line, where both circuits tripped automatically due to the breaking of two line wires. It is interesting to note that this occurred on a line that had been very conservatively designed from the standpoint of height above ground, but, on the other hand, it had practically no arcing protection. This again substantiates the point that in designing a line both preventive and remedial measures must be considered. Lowering a line, for example, will undoubtedly reduce the lightning voltage which may be induced on the line. Installing a ground wire will do the same thing. Both these measures are preventive. The purpose of the arcing protective devices, on the other hand, are decidedly remedial.

In every case during 1927 construction ground wire was brought into the station structure and, where the station structure design allowed, the number of ground wires brought into the station structure was made larger than the number on the line itself, all with the idea of reducing as much as possible the surge impedance of that portion of the system running from the last tower to the bus.

To limit definitely the amount of overvoltage that can be brought into the station apparatus a reduction in the insulating value on the first mile or so of the line coming into the station was made, all with the idea of making certain that the lightning strength of the apparatus connected to the bus was equal to, or greater than, the lightning flashover of the insulator string on the first mile of line.

Where the country did not absolutely demand it, the use of tower extensions has been kept at a minimum so as to keep the effective height of the line at a predetermined level, that level being determined, of course, by the tower design itself. In cases where the topography of the country permitted, the tension to which the conductor was pulled up was considerably reduced, resulting in a greater sag and a closer adherence of the conductor to the contour of the earth, with, of course, a net reduction of the average height of span above earth.

More attention was paid to the mechanical aspect of the arcing protection arrangements with a view to minimizing the effects of conductor vibration on the protection assembly itself.

Previously it was pointed out that unless a line was very low, generally steel tower structures, carrying power conductors of 44,000 volts and over, should be designed and installed with a ground wire. It is now believed that careful consideration should be given to the question of whether or not two ground wires would not in some cases be justifiable, with, of course, particular

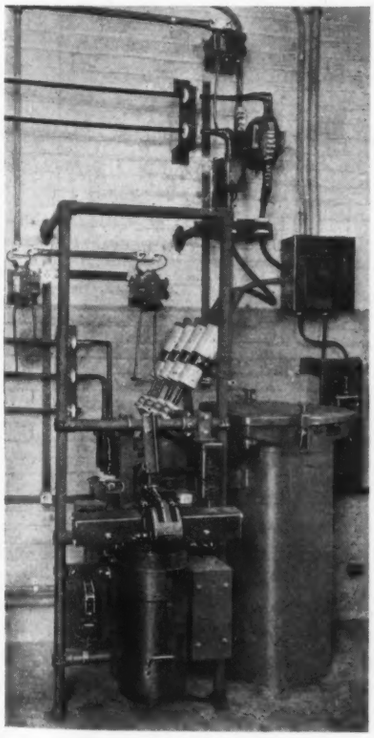
attention to the location of the ground wires as regards the main conductors. The experience with lines without ground wires, and particularly the experience obtained during 1926 on the Logan-Sprigg and Turner-Logan lines, would seem to prove definitely that it is very hazardous and extremely unwise to try to operate a line of the type under discussion without a ground wire. The limit to the voltage which can be picked up on an insulator string being the flashover of the string plus its supporting structure to ground, the likelihood of picking up voltages close to that limit will naturally be much greater without a ground wire than with it. This has been borne out by some of the 1927 experiences with klydonographs.

Switch and Transformer Oil Testing

Semi-automatic control of testing equipment expedites work. Chart record shows breakdown potential

By J. B. Wallace
Detroit Edison Company, Detroit, Mich.

THE STANDARD A.S.T.M. method of determining the dielectric strength of transformer and switch oils specifies (1) a definite settling time of five minutes for the sample in the test cup before applying potential; (2) a definite settling time of one minute between four succeeding trials, and (3) a constant rate of potential increase of 3,000 volts per second up to breakdown. Automatic recording of the breakdown kilovolts, while not specified, is also desirable to eliminate errors in observation of the swinging pointer on the voltmeter. To meet these requirements equipment has been developed for use in the high-voltage test laboratory of the Detroit Edison Company. Alternating current for general high-voltage testing is supplied by a motor-driven alternator with direct-connected exciter; the output voltage of this alternator is adjusted by a motor-driven main field rheostat with limit switches and can be varied between zero and 3,750 volts. The output of this alternator energizes the primary winding of the high-voltage test transformer, which is rated at 50 kva. with a ratio of 2,300/100,000 volts. A standard oil-circuit breaker connects the alternator output to the test transformer. This circuit breaker is operated by a G.E. type MK-1 reclosing mechanism actuated by a single-phase repulsion induction motor and fly-ball weights. This mechanism has been equipped with two potential trip coils, one of which is arranged for manual trip, remotely controlled, and the other is operated by a current relay in the secondary of a current transformer in the bus run between circuit breaker and test transformer.



SEMI-AUTOMATIC VOLTAGE CONTROL EQUIPMENT FOR OIL TESTS

BENCHBOARD FOR CONTROL OF DIELECTRIC TESTS OF OIL

The timing cycle is controlled by a Westinghouse periodic reclosing relay, which is a d.c. motor-operated drum type relay, arranged to control four circuits. Control energy is furnished by a 2¼-kw., 125-volt d.c. generator which is a.c. motor-driven. Energy for indicating lamps, alarm circuits, etc., is taken at 115 volts a.c. from a 1-kva., 230/115-volt auto-transformer across one phase of the a.c. supply to the motor-driven control generator. Operating controls and indicating instruments are concentrated on a benchboard control desk inside the test inclosure, while the timing and set-up relays are mounted on a wall panel immediately adjacent.

An Esterline-Angus recording voltmeter was rebuilt, with a spark recorder substituted for the usual inking tube. The pointer is of wood, with a vertical metal pin at the recording end and a metal segment just above and extending along the travel of the pointer. A spark coil, mounted in the case, is connected through a small transformer to the current trip relay contacts, and this arrangement causes a spark to jump, at the moment of breakdown, from the metal segment to the pointer pin and through the chart to the chart table, thus marking the breakdown voltage with a small puncture in the chart. A small solenoid, actuated through the contacts of the circuit breaker closing relay, advances the chart one space between successive trials. The chart table has been made wider to facilitate writing oil sample identifications on the record, and the pointer is separated from the writing space by a heavy curved glass barrier. The entire recording assembly is mounted in a movable desk equipped with rubber roller casters and a three-circuit, six-conductor, flexible cable from the recording instrument is arranged to plug the three circuits simultaneously into the proper terminals of a six-point jack on the benchboard. The oil-test cup used with this equipment is an adapta-

tion of the standard Westinghouse cup provided for use in dielectric breakdown tests of oil.

The indicating and alarm circuits are energized and control generator voltage is adjusted to a point at which the main field rheostat motor will raise the test voltage at a rate of 3,000 volts per second. This point has been predetermined.

The alternator is started and brought up to speed with voltage at zero. The oil-test cup is cleaned, dried, rinsed and sample poured in. The timer motor circuit is closed at the benchboard and the timer started manually. After 4½ minutes elapsed time a set-up relay establishes the closing circuit up to the timer contacts. After five minutes the timer closes the circuit and stops, the main circuit breaker closes also, closing the auxiliary switch and starting main field rheostat motor in "raise" direction. The voltage increases at 3,000 volts per second to oil breakdown. At breakdown the current-trip relay closes one circuit to the recording voltmeter spark coil and one circuit to the trip coil.

The main breaker opens, opening the "voltage-raise" auxiliary switch and closing the "voltage-lower" auxiliary switch and timer-motor circuit. The main field rheostat returns to zero, while the timer runs one-half minute to the set-up point. One minute after the first oil breakdown the main breaker closes and the second run-up to breakdown is made. This cycle is repeated for a total of five breakdowns. After the fifth breakdown the main field rheostat returns to zero, the timer closes an alarm bell circuit for five seconds and the timer-motor circuit opens through a timer-drum contact. It cannot again be closed until the timer drum is manually rotated to the starting position.

The testing cycle is repeated twice and the mean of the averages of the three series of five trials each taken as the dielectric strength of the oil under test in the standard gap used. Using this equipment, the standard A.S.T.M. oil test can be completed on a given oil sample in about 40 minutes and requires less than one quart of oil.

Reducing Distribution Losses

NINTH ARTICLE

Graphic Ammeter Tests

By J. B. Moorhouse

Electric Distribution Engineer Central Illinois Public Service Company, Springfield, Ill.

LOAD-CHECKING graphic ammeters are mounted in two-compartment steel boxes similar to those used for voltmeters and illustrated in a previous article of this series. A receptacle must be provided for a lamp or heater unit inside the steel box in order to keep the clocks warm during cold weather. A 25-watt lamp gives off sufficient heat if the door of the box fits properly.

In checking distribution transformer loads on either the primary or secondary side a current transformer must be used. A check on the secondary side is preferable in that: (a) Service need not be interrupted while connecting instruments; (b) connection of instruments on secondary voltage is less hazardous; (c) the current balance on the two legs of the transformer can be obtained.

All graphic ammeters on the market today operate at a relatively high load. To insure accuracy of results special solid core current transformers are used by the Central Illinois Public Service Company. Compensation, correct for use with Westinghouse type "U" graphic ammeters, is provided for by removing secondary turns of the winding. Variable ratio primary is provided by tapping the primary winding. In order to check all sizes of distribution transformers from 3 kw. to 37½ kw. ratios of 200, 100, 50 and 25.5 amp. are most convenient. These ratios, being in even multiples of five, are readily applied to the 0-5 amp. scale of the chart.

Securing Clean Air for Synchronous Condenser

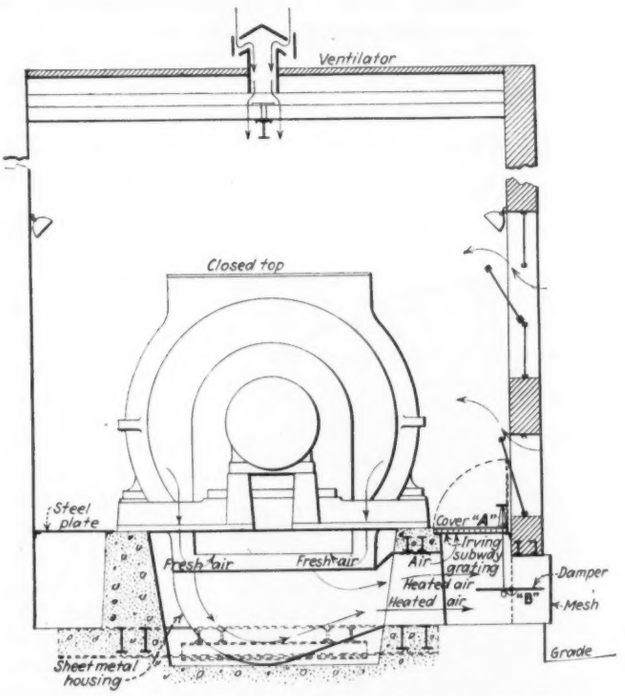
Low intake velocities and selected entrance points reduce air impurities in machine ventilation

By H. W. Herrlich

Electrical Design Engineer Utica Gas & Electric Company

DUE to local conditions, a closed, circulating, air-cooling system could not be used in the installation of a 15,000-kva., 13.2 kv. synchronous condenser at the Washington Street station of the Utica Gas & Electric Company.

The proximity of the station to a water gas plant and to a large boiler plant compelled the greatest caution in the drawing in of free air, as a considerable deposit of



COOLING SYSTEM AVOIDS ENTRANCE OF EXTRANEOUS MATERIAL

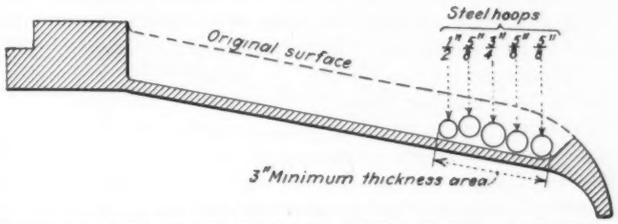
fine cinders covered the ground for a great distance. It was therefore decided to draw in the required amount of air for cooling with the least velocity. This could quite readily be accomplished through the roof ventilators, windows and doors. Normally, the air is discharged through a screened opening on the side of the building, as indicated in the sketch, but during cold weather the butterfly damper, *B*, is closed, the cover plates, *A*, lifted, and the heated air enters the room. Almost all of the switching equipment is located in the same room with the condenser and is kept practically free from deposit of cinders. The condenser has been in constant use since the spring of 1923 and has shown at the annual inspections of the plant that there is practically no abrasive action on the coils and a very small deposit of cinders and dust.

The air ducts are free from goosenecks, short bends and other obstructions, permitting the condenser to carry considerable overload, without exceeding the guaranteed temperature rise.

Electric Welding Saves Waterwheel Casing

A SERVICE interruption of three months, the investment of about $1,000 in a new casing and loss of power during a high-water period were saved recently in a New England generating plant by electric welding, at an expense not exceeding $175, applied to a leaky hydraulic turbine. Describing this job before the Affiliated Technical Societies of Boston, C. W. Babcock, sales engineer Boston office Westinghouse Electric & Manufacturing Company, stated that the wheel in question ran under about 150 ft. of head and had been patched from time to time until leaks through the casing forced a shut-down. The wheel manufacturer quoted three months' delivery and a price of about $1,000 on a new casing, but the company could not wait for this. It was decided to try arc welding as a last resort.

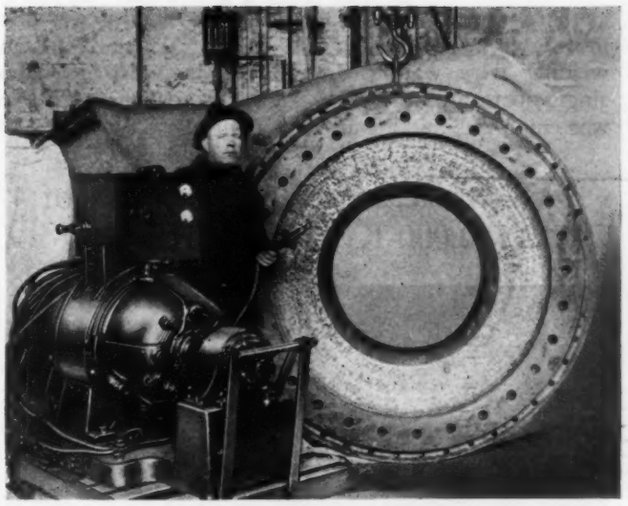
During years of operation the outboard and thrust bearing had worn gradually, and the runner moved laterally until it touched the casing and wore away a section about 10 in. wide and 1 in. deep entirely around it. In



SECTION OF CAST-IRON WATERWHEEL CASING, ELECTRICALLY WELDED

one place the casing was worn through and in other spots it was from $\frac{1}{16}$ in., or less, to $\frac{1}{4}$ in. thick. A patch had been placed over the weakest parts. Owing to the extreme thinness of the iron near the inside radius of the worn section it was impossible to weld or deposit metal on the casing itself. The arc would have burned through as fast as established. This space was, therefore, bridged by a series of steel rings welded together and to the casting, and the remainder of the area welded in, as indicated in the drawing.

In handling this work a $\frac{5}{8}$-in. ring was welded to the neck of the casing. A second hoop of this size was

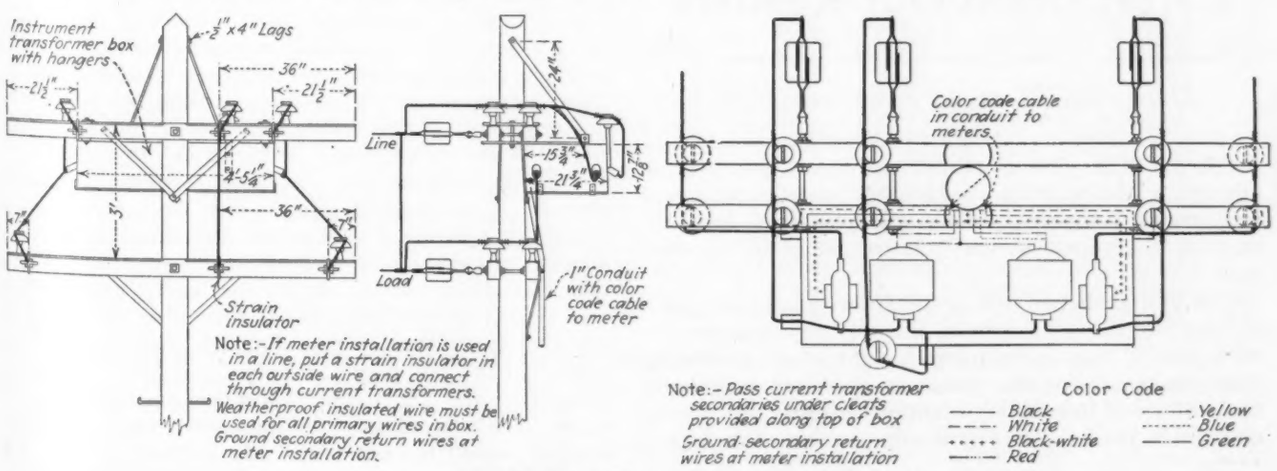


CASING AFTER WELDING AND PORTABLE WELDER USED

placed outside the first and welded to it across the top. A third hoop, $\frac{3}{4}$ in. in diameter, was then put in place and welded to the second. A fifth ring $\frac{1}{2}$ in. in diameter, was then placed at a distance from the third that the fourth hoop, $\frac{5}{8}$-in. diameter would be raised up from the cast-iron when finally put in place. The fifth hoop was welded to the casting on the outer side. This was done to prevent the fifth ring from pulling or shrinking from the cast-iron, as it might have done if first welded to the fourth. The fourth hoop was then dropped into place and welded to the third and fifth rings. A small piece was cut out of each ring before welding, to allow for expansion, and the gap filled in later. These gaps were staggered. This made a strong bridge over the thin section and the entire remaining area was welded in without great difficulty.

While welding directly on the cast-iron, the welder ran a bead of only 1 or 2 in. at a time in one spot, and a helper immediately peened this with a hammer to strengthen it and avoid porosity. The first layer of welding to the cast-iron was done with a special grade of welding wire for cast-iron, succeeding layers being put on with ordinary steel welding wire. After welding, the high spots were ground off with a portable wheel, the reinforcing patch outside the casing being left in place,

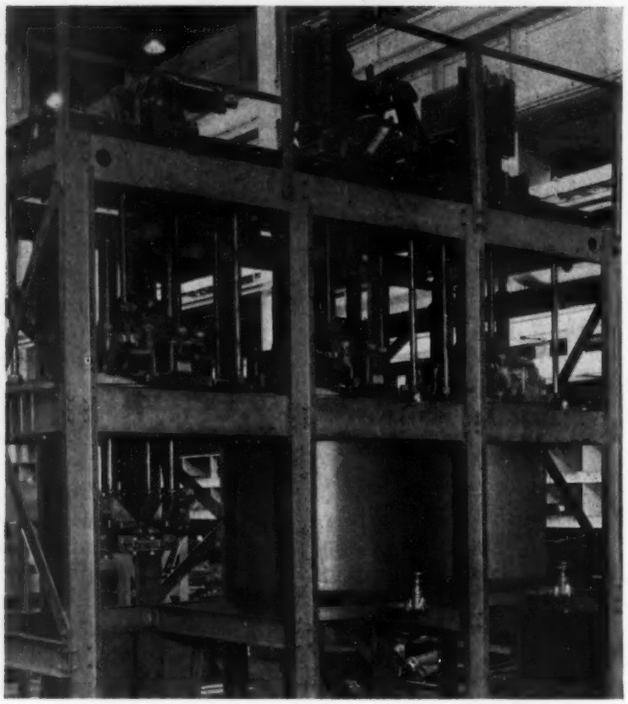
Three-Phase Pole-Top Instrument Transformer Box Installation


Instrument transformer box with hangers
1/2" x 4" Lags
36"
21 1/2"
4'-5 1/8"
3"
7"
Strain insulator
Line
Load
1" Conduit with color code cable to meter
Color code cable in conduit to meters
Note:- If meter installation is used in a line, put a strain insulator in each outside wire and connect through current transformers. Weatherproof insulated wire must be used for all primary wires in box. Ground secondary return wires at meter installation.
Note:- Pass current transformer secondaries under cleats provided along top of box
Ground secondary return wires at meter installation
Color Code
Black
White
Black-white
Red
Yellow
Blue
Green

Standards of West Penn System

as there was no object in removing it. The job was done in one week by a welder and helper. About 250 lb. of welding wire was used. A Westinghouse 200-amp. single-operator arc welder of the motor-generator type was employed, and about 300 kw.-hr. were consumed.

Mechanical Strength a Feature of 2,500,000-Kva. Circuit Breaker



NO PORCELAIN is used in the construction of a new type high capacity breaker now being built by the Westinghouse Electric & Manufacturing Company, as this material is considered to be inadequate to meet the mechanical stresses that may occur. The manufacturer believes that this type of equipment, which is supplied for 15,000- and 220,000-volt service, will meet any system capacity needs for some years to come.

Letters from Our Readers

Designing Plants in Economic Units

To the Editor of the ELECTRICAL WORLD:

Alfred Iddles has employed the logical method* in attempting the solution for the most economical set of proportions. He first divides the plant into sections, each of which may, by itself, be treated as an economic unit.

The first economic unit is the steam-generating plant. Having determined which of the sets of conditions investigated is most economical for the steam-generating plant, he next, for the resulting operating conditions, finds which of the sets of conditions investigated is most economical for the power-generating section of the equipment. The latter section of the plant is thus the second economic unit.

In general, it may be stated that there is a set of proportions for any structure which will prove most economical. The discovery of this particular set of proportions is predicated, first, on ascertainment of the economic units into which the structure or system may be broken up. An economic unit is a part of the system such that the variations considered have little or no influence on the cost of operation in the part of the plant extraneous to the unit under consideration. Thus it is implied in the method of analysis here outlined that variations of proportions in the steam-generating plant will not materially influence the cost of operation in the power generating plant, and vice versa.

The economic factor is that expression which in general terms expresses in some way the cost of operation of the economic unit. It includes terms whose magnitudes are fixed when the physical proportions and load conditions are fixed and whose value changes when any one of these conditions is altered.

Curves plotted between axes, one of which is the economic factor value and the other some physical proportion of the unit, may be called the economic characteristic and show at a glance what is involved economically when the proportions of the unit are altered.

Usually such curves may be arranged to show maximum or minimum values at the best set of proportions, depending upon whether the economic factor is set up to express a saving in money or total cost of operation.

Mr. Iddles has chosen, for the sake of simplicity, to fix the surfaces in the economizer and air preheater. His conclusions, then, regarding whether or not economizer and, or, air preheater surfaces should be installed, apply strictly only to the amounts of surface in question. There may be and probably are smaller extents of both types of surface which would prove economical in use, even though the interpretation placed on the results is that in some instances economizers and, or, air preheaters are not economical. The reader might well be referred here to a recent paper by Mr. Van Deventer entitled "Economics of Air Preheater Applications," A.S.M.E. national fuels meeting.

The economic factor as set up by Mr. Iddles is thus restricted in certain proportions and represents directly differences in operating costs for the several sets of conditions chosen, and the only conclusion justifiable is that some one of these sets of conditions is more economical than another. But to say that because, for instance, Case I is more economical than Case II air preheaters are not justified is obviously a generalization based on insufficient information. All that may be said is that as much air preheater surface as is included in Case II is not justifiable. The conclusions stated under (2) on page 194 are thus subject to the above criticism.

Perhaps the same type of criticism may apply to conclusion (3) on page 194, as in view of our experience with both pulverized fuel and stoker fired boilers it is difficult to believe that it is generally true that it will take nine-dollar coal to justify the use of a pulverized coal system of the bin type. If this is so, then there is still the unit system, which, although mentioned by the author, has not been brought into the discussion. Obviously, the high fixed charge and maintenance account which handicaps the bin type system in this analysis would have to be greatly reduced for the unit system.

PROF. W. J. WOHLENBERG.
Yale University.

*"*Economy of High Efficiency in Medium-Sized Power Stations,"* ELECTRICAL WORLD, *page 189, Jan. 28, 1928.*

Digest of Electrical Literature

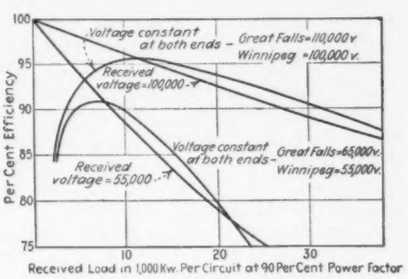
Generation, Control, Switching and Protection

The Klingenberg Power Station, Berlin.—This station has a present capacity of 270,000 kw. and renders the city of Berlin independent of outside electrical sources. The various features of the station, including the method of receiving the coal, and steam and electric generating data and features are given. Steam is generated at 514 lb. per square inch and 797 deg. F. The boiler drums and superheater-tube suspension offer unusual features. All the combustion air is preheated to 302 deg. F., a portion of it being extracted and mixed with cold air for use in the primary air-fuel mixture. The remainder is drawn by suction into the combustion chamber. The generating equipment consists of three sets, each having an output at a continuous rating of 100,000 kva. Each set consists of a main machine of 80,000 kw. capacity and an auxiliary machine with an output of 10,000 **kw**. The turbines operate at 478 lb. per square inch and 752 deg. F. Each consists of a triple-expansion cross-connected turbine with twin low-pressure portions and drives two generators of equal output. The two parts of each turbine are arranged parallel and alongside one another, each set being placed one behind the other along the longitudinal axis of the turbine room. Control is obtained from a main control room, where an instrument indicating the conditions on the steam and electrical sides allow a close supervision of all operations. Transformers raise the generator voltage of 6,000 to 30,000 volts and are connected directly to the 30,000-volt bus bars for subsequent distribution. — *Engineering (England)*, Jan. 13, 1928.

Transmission, Substations and Distribution

The Grounding of a Long-Distance Transmission Line Compensated Through Petersen Earth Coils.—TAKASHI OHTSUKI. — The author has endeavored to cover the subject of the grounding of long-distance transmission lines, and the general equations of a transmission line grounded at any point on the line with any treatment of its neutrals have been derived with consideration for all distributed line-constants so that an accurate tuning condition of the earth coils may be obtained. The electrical conditions resulting from the accidental grounding of a line are theoretically investigated for various probable causes so that the number and location of earth coils on a transmission line for the most favorable results are covered. It is stated that for practical purposes it is generally sufficient to take into account only the total line capacitance in order to determine the necessary compensating value of the earth coil on the comparatively short line, but that when the line to be compensated is longer it is increasingly important for the accurate tuning of the earth coils to be considered in connection with the line inductance. Formulas for the three-phase transmission line are derived and comparison with those for a single-phase system with general tuning conditions of the earth coils permits the establishment of an expression for symmetrical *n*-phase, *n*-line system. The effect of the third harmonic electromotive force acting on the system is discussed with relation to the treatment of the neutral point.—No. 14, *Selected Papers from the Journal of the Institute of Electrical Engineers of Japan.*

110-Kv. Great Falls-Winnipeg Line. —L. M. HOVEY.—The new transmission line of the Manitoba Power Company is described in this article in connection



EFFICIENCY LOAD CURVES FOR TRANSMISSION LINES

with the design features involved and the considerations which influence their determination. Two-circuit steel-tower transmission lines are used with some unusually high structures and with long spans. Steel-reinforced aluminum conductors have been utilized in this installation. The features of the synchronous condenser operation and of the river crossing cables are developed. The methods of calculating performance of lines are given and the computed variation of efficiency with the received loads under potentials of 55,000 and 100,000 volts are also given.—*Electrical News (Canada)*, Jan. 15, 1928.

Series A.C. Transmission. — HENRY M. SAYERS.—A discussion of the possibilities of the distribution of alternating-current electrical energy in certain areas by means of a constant current primary-ring main circuit with variable current secondary or load circuits. A definite scheme is offered for the practical application of this idea. The growing demand for electricity supply in rural areas is said to be satisfied economically by the plan outlined by the author, who also offers as an example a solution for a specific distribution problem to which his plan might be applied.—*Electrical Review (England)*, Jan. 13, 1928.

Units, Measurements and Instruments

Cathode-Ray Tube for General Alternating-Current Measurements.—MRS. Z. TSCHERDANZEV. — With the aid of a Brownian tube and a few properly dimensioned deflection coils most of the conventional a.-c. measurements can be readily performed with a high degree of accuracy. This little known and utilized fact is described in this paper. Current, voltage, frequency and power-factor measurements require but few accessories and a simple calibration. If higher harmonics are to be evaluated a basic sinusoidal wave must be available, which can best be derived from a small magneto-motoric induction machine. The Brownian tube can also be used to show to large audiences the characteristics of synchronous machines, commutator machines and other electrical machines and apparatus. It is claimed that for school or lecture purposes this method of measuring and demonstration is less expensive than the commonly employed double or triple element oscillograph.—*Elektrotechnik und Maschinenbau*, Jan. 15, 1928.

The Hall High-Speed Recorder.—E. M. TINGLEY.—A new form of oscillograph for recording fault currents and their voltage-disturbing effects in electric power systems is described. Representative records are analyzed and further applications of the instrument are suggested. Tests were conducted in connection with the operations of a large power company, and, in the opinion of the author, the high-speed recorder proved its value for such work. The recorders have been found to be useful for oil circuit-breaker tests and for measuring effects of test currents upon the system. The long time scale allows the starting of the instrument by telephone orders and consequently involves no lost intervals such as occur with other methods. Both generator and substation voltage disturbances may be accurately measured with the instrument.—*Journal American Institute of Electrical Engineers*, January, 1928.

Heat Applications and Material Handling

Electric Home Cooking.—F. MARTI. —The author investigated the status of electric home cooking in a number of European countries with the object of further stimulating its application in Switzerland. Of the 750,000 Swiss homes, one-half cook with gas and 100,000 have electric stoves. Full electrification would require annually 600,000,000 kw.-hr., which could be taken care of by the new hydro plant at Ryburg alone. Statistical data which have been collected by the author indicate

that 1 kw.-hr. is required per person per day when meals are cooked electrically with the customary type of hot-plate stoves. The resulting load is exceedingly irregular, calling for three short daily demands, with the highest and sharpest peak near noon. A much more desirable load character could be secured for the central station by a more general use of the heat-accumulating type of stove, the heating element of which remains connected for sixteen hours per day, transmitting its heat to a well-lagged heavy metal block. Several constructions of such stoves are described, in particular Scandinavian types, of which excellent performance records are available, Comparing the current consumption of a hot plate and an accumulating type of stove, the latter requires about 17 per cent more energy, but since long periods of heating fall into off-peak periods with a lower rate, the total kilowatt-hour expenditure is less. A large number of practical statistical data are given from cooking experiences in several European countries. —*Bulletin de l'Association Suisse des Electriciens,* January, 1928.

A New Electric Welding Set.—C. H. S. TUPHOLME.—The apparatus consists of what the designers call a compensated rotating transformer capable of giving 60 or 30 volts alternating current with a drooping characteristic similar to that of the direct-current welding generators. Although employing alternating current, it is possible to weld at 30 volts with a current of 200 amp. In this equipment the rotary transformer acts as a static transformer while the motor is stationary, but as soon as the latter starts the primary winding rotates inside of the secondary, inducing a current, the frequency of which varies with the speed of rotation. It is possible to synchronize the single-phase pulsations in the welding circuit with that of the current in each of the supply lines, whatever the number of phases. The rotary also acts as a generator and can be constructed to give a wave form which will produce perfect conditions for efficient arc manipulation.—*Electrical Review (England),* Jan. 20, 1928.

Telegraphy, Telephony, Radio and Signals

The Short Wave Limit of Vacuum-Tube Oscillators. — C. R. ENGLUND. — An investigation of the short-wave limit of vacuum-tube oscillators of the normal type where regeneration builds up oscillation in a resonant circuit indicates that the physical limits for ordinary commercial tubes lie between 3.5 and 1.5 m., depending on the type of tube used. By means of a special tube a wave length of 1.05 m. was obtained. No frequency control was left at this wave length. With a small power tube, deviating but slightly from ordinary vacuum construction, it was possible to operate at 3.5 m., with adequate frequency control, and it is concluded that the 3.5-5-m. range is available for technical purposes. The apparatus utilized in the measurement of wave lengths and the methods used in computing capacity and inductance under the conditions of this test are included. —*Reprint B-278 Bell Telephone Laboratories, Inc.*

Electrophysics, Electrochemistry and Batteries

Chromium Plating.—S. WERNICK.—The fundamental considerations involved in the somewhat recent development of chromium plating are reviewed by the author. Statements regarding the wear-resisting surface offered by this metal and the technical problems which must be solved in its application to other metals are offered in connection with a consideration of the chemical and physical properties of the material. The process of deposition and the apparatus required for satisfactory results are reviewed. It is stated that chromium cannot be suitably cast into anodes for use in the electrolyte and that even were this possible a serious drawback would be involved in the rapid rate of dissolution of the anode as compared with the deposition of metal at the cathode, rendering the proceeding impractical. The factors which require the use of lead anodes are reviewed. It is stated by the author that the actual cost of chromium plating may be considered to vary from less than twice to five times the cost of nickel plating, depending upon the facilities available and the general organization of the plating shop.—*Electrical Review (England),* Jan. 13, 1928.

Electro-Thermic Saw.—O. NEISS.—A circular saw for cutting heavy structural steel sections quickly and cleanly is the subject of this article. Experiments carried out by the author showed promising results if a low-voltage but high-intensity current is passed between the blade of a circular saw and the metal to be cut. The arc formed at the cut liquefies the metal and hastens the cutting speed very materially. The first saws built used the secondary of a transformer to provide about 16 volts and 5,000 amp. It was found, however, that such a saw has many disadvantages, such as short life of the blade, a poor power factor and a very irregular load demand. Conditions could be improved only if direct current could be used for the cutting. An ingenious and entirely novel machine design was therefore dedeveloped by the author, combining the saw with a unipolar type of dynamo into one unit. The cylindrically enlarged saw arbor serves as the unipolar inductor, with excitation coils placed around it and the hub of the saw blade. Several sets of brushes collect the current from the arbor. An effective voltage of about 10 at 4,000 amp. is available at the cut. The saw is driven by a 2,000-r.p.m. motor. The blade has a diameter from 30 to 60 in. A 12-in. I-beam can be cut in twenty seconds, requiring only 0.28 kw.-hr.—*Elektrotechnische Zeitschrift,* Jan. 19, 1928.

Electric Storage Batteries. — E. C. MCKINNON.—The author offers a general review of the subject of electric storage batteries as applied to generating and substation work. A description is included of a portable instrument which may be inserted in the water used for electrolyte make-up purposes for instantaneous determination of its suitability for such use. This device consists essentially of two platinum electrodes so arranged that when they are immersed in water containing a definite percentage of chlorine a specific current will pass under the pressure of a standard potential. Calibration has been so arranged that suitable make-up water will cause very small deflections to be recorded upon the scale, while unsuitable material will be given a high reading. Various procedures suggested for insuring satisfactory operation and long life of storage batteries are suggested by the author as a result of a review of contemporary British practices which are indicated as having given satisfactory results. — *Electrical Review (England),* Jan. 13, 1928.

Miscellaneous

The Dvorkovitz Carbonization System. — The recent tendency in low-temperature carbonization processes to exceed 500 deg. C., rather than to fall below it, produces a great amount of cracking of the oil vapors in the carbonizing effects. A practical difficulty has entered the situation in that the charge tends to become cemented together by its plastic constituents before the oils have been sufficiently removed. This caking impedes both the penetration of heat into the mass and the escape of oil vapors before they are cracked and with some coal and retorts may hold the charge in the retort and interrupt the progress of the operation. An experimental unit has been installed to enable an exact investigation to be made from coal used in commercial carbonization processes. — *Engineering (England),* Jan. 20, 1928.

Control of Cable Impregnation.—P. JUNIUS.—What seems to be a much more reliable control of impregnation is described. The principle of the new treatment is that when the raw cable is placed in the tank its conductors are connected to an airtight multi-outlet plug in the vacuum tank cover. During the entire drying process continual electric records can be made of the condition of the cable within the tank. Since the dielectric loss of raw paper is 1.8 to 2.6, while that of oil-impregnated cable paper is 3.4 to 4.3, the process of impregnation can be controlled by continuous measurements with an a.-c. bridge method. In addition, impregnation increases the capacity of the cable, so that capacity measurements can be made to check further the proper treatment of the cable and to determine the point beyond which the quality of the cable can no longer be improved by the application of impregnating materials.—*Elektrotechnische Zeitschrift,* Jan. 12, 1928.

News of the Industry

Trade Commission for Thorough Inquiry

Invokes Its Own Powers to Make Legality of Investigation Beyond Question—Joint Committee Offers Its Aid—Muscle Shoals Now Unfinished Business

By Paul Wooton
Washington Correspondent of Electrical World

IMMEDIATELY upon the passage by the Senate of the Walsh resolution, as amended by Senator George, the Federal Trade Commission began its preparations for the handling of the work. It is very evident that the commission has been put on its mettle by the charges made in the Senate, and a very thoroughgoing job is in prospect.

In view of doubts expressed on the floor of the Senate as to the power of the commission to comply with all features of the resolution, the commission has invoked its own powers to initiate investigations in order to remove any doubt as to its authority to investigate at the behest of a single branch of Congress. It was pointed out that the commission has the right to initiate an investigation covering every phase of the inquiry ordered by the Senate. Immediately on receiving official notice that the resolution had been approved the commission adopted the following resolution:

Whereas the Senate of the United States has by a resolution agreed to on Feb. 15, 1928, directed the Federal Trade Commission to make an inquiry into certain practices and conditions relating to specified classes of public utility corporations and corporations connected therewith, now, therefore, be it

Resolved, that an inquiry shall be undertaken immediately by the commission in strict and full compliance with the terms of the said resolution, and that in the prosecution of said inquiry the commission shall rely on and employ the powers conferred on it to make investigations at the direction of either house of Congress, and any and all powers conferred upon it by law to conduct inquiries on its own initiative or otherwise, and any other powers legally available to it, whether contained in its organic act or elsewhere, which may conduce to a diligent and complete performance of the ends and purposes set forth in said resolution.

As this is written, the commission has not decided upon the exact method which will be followed in the conduct of this investigation. Usually such work is assigned to the economic branch of the commission, but occasionally investigations are assigned to a member of the commission who takes immediate charge and keeps in constant touch with the progress of the work. It is not improbable that this procedure will be followed in this case.

J. T. Newcomb, counsel of the Joint Committee of National Utility Associations, in charge of its Washington office, made a formal appearance before the commission on Feb. 20. He called the attention of the commission to the fact that one of the principal purposes of the joint committee is to make available officially to the government information, studies, engineering data, operating experience or other data relating to the utilities which may be useful to any government agency. He stated that he had been instructed formally to tender the services of the joint committee in connection with this inquiry. He assured the commissioners that the committee will do all in its power to assist in making the investigation a thorough one.

Secretary Tydings of Maryland, one of those who voted to intrust the public utility investigation to the Federal Trade Commission, has served notice by letter to Chairman Humphrey that if the commission fails to make a "complete, searching, fair and non-political probe," he will introduce a bill to abolish it as a "useless million-dollar-a-year expense" to the taxpayer.

Norris Bill Unfinished Business

The Senate on Feb. 20 made the Norris Muscle Shoals resolution the unfinished business before that body. This probably indicates an early vote on the proposal to lease the power developed at the Wilson Dam and to use the proceeds for the experimental production of fertilizer. Objection to the Norris resolution is entertained by some members of the Senate on the ground that it opens the way for the entry of the government into the electric power and fertilizer businesses.

Senator Sackett of Kentucky has offered a substitute resolution which provides more specifically for the promotion of the use of concentrated fertilizers on the nation's farms. His resolution also carries the item to which objection is made, authorizing the Secretary of War to construct transmission lines. The Sackett substitute eliminates the government operation feature of the power plants, but makes no provision for the equitable distribution of the power. After the energy is developed the Norris bill provides for its equitable distribution. The Sackett substitute provides for a fifteen-year lease as compared with the ten-year maximum in the Norris proposal.

Another substitute for the Norris proposal has been introduced by Senator Tyson of Tennessee. He proposes to lease the power generating properties for a period of twenty-five years, but in the event that the Secretary of War is unable to secure a satisfactory lease within a reasonable time, he is required to operate the power plant and contract for the sale of power. Upon reasonable notice, however, the lease may be canceled after the expiration of ten years. Both the Tyson and Sackett proposals provide for the encouragement of the use of concentrated fertilizers.

Consideration of Boulder Dam legislation is proceeding in executive session before the irrigation and reclamation committee of the Senate. The bill is now being read for amendments and progress is reported to be slow. There has been no change in the position of the House committee.

Chicago Company Adopts Optional Room Rate

Commonwealth Edison Figures that a Substantial Saving to 91½ per Cent of Its Residential Customers will Result from Change

ON FEB. 15 the Commonwealth Edison Company of Chicago filed with the Illinois Commerce Commission a new tariff of residential rates which the company figures will save customers $1,300,000 a year on the basis of consumption in 1927. The new schedule, which is to be optional and is based on counted rooms, will apply to meter readings taken on and after April 1. It will impose a charge of 7 cents per kilowatt-hour for the first 3 kw.-hr. per room per month, 5 cents for the next 3 kw.-hr. per room per month and 3 cents for energy in excess of 6 kw.-hr. per room per month. The present rate is 8 cents per kilowatt-hour for the first 30 hours' use per month of the maximum demand, 5 cents for the next 30 kw.-hr. and 3 cents for any excess over 60 hours' use.

Since 91½ per cent of all residential users of electricity in Chicago live in homes of from three to seven rooms, the monthly bills of that percentage will, the company estimates, be reduced, assuming the same amount of use; but any dissatisfied customer will be at liberty to revert to the former schedule. The last previous reduction in Commonwealth Edison rates—the thirteenth—was in August, 1923. In 1927 the average residential electric bill was $2.29 a month, and the average rate paid by residential customers for electric service was, the company says, 5½ cents per kilowatt-hour.

Economic Aspects of Power Production

Midwest Power Conference Combines Engineering and Commercial Consideration of Generation and Utilization— President Glenn Frank's Prophecy

BROADER economic aspects of the relation between the production and utilization of power by industry and business held the stage at the third annual Midwest Power Conference, on Feb. 14 to 18, at the Hotel Stevens, Chicago, where nearly one thousand utility and industrial engineers and executives assembled.

Speaking at the opening session, Dr. Glenn Frank, president of the University of Wisconsin, portrayed the part that power promises to play in the future of our civilization. He pointed out that a machine civilization in which power can be taken to the worker is radically different from a machine civilization in which the worker must go to the power. Among several other important things, it means that even the mass production of goods and machines can be carried on in a decentralized industry, whereas a civilization in which the worker must go to the power means that mass production cannot be carried on save in a centralized industry. Once the cheap transmission of power decentralizes industry as it is now doing, most of the ugly social problems created by industrial centralization in congested cities will disappear automatically.

In his opening address Major Rufus W. Putnam, chairman of the conference, predicted that Illinois, Indiana, Wisconsin and Michigan will add eight million to their present population of seventeen million in another thirty years. He outlined the effect of increased population and industrial activity upon the use of power and pointed to the major transmission systems of the utility companies in the Great Lakes region which are being extended to meet these requirements.

Power's accomplishment in the factory and home was the topic of discussion at Tuesday afternoon's general session, when W. A. Durgin, director public relations Commonwealth Edison Company, gave an illustrated address.

Picturing electricity as the great burden bearer of mankind, R. Burke Corcoran, manager of the Electric Association, Chicago, pointed to the fact that $930,000,000 has been invested by the public of Chicago in electric wiring, appliances and equipment to promote human comfort, convenience and happiness.

On Wednesday the conference was given over largely to discussion of power problems, their relation to flood control and development of national and international waterways. Construction of reservoirs as a means of flood control was declared by two speakers to be in most cases economically unsound and physically inadequate. These speakers were General Edgar Jadwin, chief of engineers, U. S. A., and Daniel W. Mead, Madison, Wis., who analyzed in detail the work accomplished by such projects in Minnesota and Wisconsin.

Irrigation, flood control and possibilities of power development on the Colorado River were discussed by Colonel William Kelly, Buffalo, who compared the proposed Boulder Dam project with what he considered less costly and equally satisfactory methods of accomplishing the same end. Major G. E. Edgerton, chief engineer of the Federal Power Commission, said that while, on the whole, the present status of hydro-electric development is, perhaps, satisfactory, it can scarcely be described as gratifying. Navigation and projected power development on the St. Lawrence River were discussed by E. A. Forward, consulting engineer, Montreal.

H. A. Hageman, chief hydraulic engineer with Stone & Webster, Boston, described increased efficiency in hydraulic power equipment.

At the annual banquet on Wednesday evening Rufus C. Dawes spoke on "Engineering Phases of International Finance," with particular reference to international credits.

Economics of Power Stations

Alex Dow, president Detroit Edison Company, speaking in his characteristic style on capital costs with relation to economy of central stations, urged upon engineers that in the design of power plants there be a careful balance of efficiency against total cost. Mr. Dow pointed out that in striving for high thermal efficiencies sight is sometimes lost of the fact that the cost of obtaining the last few per cent of increased efficiency may far outweigh the benefits derived.

Discussing operating experience with high-pressure and high-temperature steam, George A. Orrok, New York Edison Company, described a number of high-pressure installations in operation. Experience showed no serious difficulties in the way of operating plants up to pressures of at least 2,000 lb. per square inch and that the operation of superheaters raising steam temperatures to 850 deg. F. with ordinary steel superheater tubes was commercially practicable, but the most economical pressure and temperature for any given case have yet to be determined.

"Trend and Development in Steam Generation" was discussed in a paper by Thomas E. Murray, New York. Large installations and operation at higher production rates are the order of the day, he said, and it is now possible to obtain boiler production rates of more than 1,000 per cent in continuous operation. At present plans are being made for boilers having a capacity of 800,000 lb. of steam per hour, and this may be increased to 1,000,000 lb.

Methods and developments in power transmission were topics of discussion at a luncheon symposium on Thursday, at which H. W. Eales, H. M. Byllesby & Company, stressed the precautions which utility companies are taking to insure reliability of electric service to industrial plants and the communities supplied by the power companies' overhead transmission lines. Power transmission by high-voltage cables, methods of supplying power to industrial plants by cable circuits and use of ring circuits were discussed by H. B. Gear, Commonwealth Edison Company. Developments in power-transmission systems were outlined by A. C. Montieth, Westinghouse Electric & Manufacturing Company, and some of the causes of failures in impregnated insulated lead-sheathed cables were analyzed by W. S. Clark, General Electric.

Fuel and combustion economies of power stations were the topics of Friday morning's sesions, at which papers were presented by T. A. Peebles, Hagan Corporation, Pittsburgh; J. F. Shadgen, Smoot Engineering Company, New York; Edward Brown, Allis-Chalmers Company, Milwaukee, and Dr. S. W. Parr and F. C. Straub, University of Illinois.

Speaking on "The Engineer's Part in Business" at a luncheon meeting of the American Society of Mechanical Engineers on Friday, W. S. Hovey, president Fairbanks, Morse & Company, emphasized the need for the commercially minded engineer.

Coincident with the conference, the third annual Chicago Power Show, with 275 leading manufacturers of power and electrical machinery exhibiting, was held at the Coliseum under the auspices of the Midwest Engineering and Power Exposition.

Electric Heating Load and the Central Stations

At a meeting of the electric furnace section of the National Electrical Manufacturers' Association held in Detroit, Feb. 21, organization of the section was completed and plans were made looking to improvement of trade practices and more intensive development of the market. In discussing the extent of available business it was contended that the central-station companies, the principal beneficiaries from having the electric heating load connected to their lines, have so far failed to put forth the amount of engineering and sales effort that the value of this class of business seems to warrant. In order to present a better and more complete picture of the amount of electric heating load that is being added and as a guide to the extent of the business the furnace manufacturers have agreed to collect statistics giving the number of furnaces, total kilowatts and value in dollars of sales in units up to 100 kw. and of 100 kw. and over. This information is to be collected and published monthly.

Harvard Medal Awarded to J. H. McGraw

Publisher of "Electrical World" Honored for His Distinguished Services to Advertising—He Discusses the Part of Advertising in Building American Industry

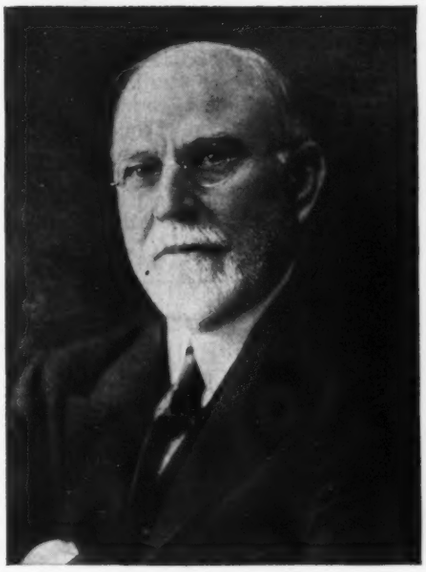
TO JAMES H. McGRAW, president of the McGraw-Hill Publishing Company, last week was awarded the gold medal "for distinguished contemporary service to advertising," given under the Harvard Advertising Award, "because of his lifelong service in the upbuilding of higher standards in advertising in the business press of the country and his pioneering work in the recognition of advertising relations to marketing." The presentation was made at a dinner on Friday night in Boston under the auspices of the Graduate School of Business Administration of Harvard University. This is one of the four awards established by Edward Bok as an expression of the conviction that advertising, wisely utilized, is a great economic power to broaden markets and decrease the cost of distributing goods, but, if unscientifically employed, is wasteful to the community. Mr. McGraw is the third person to be honored with this medal.

In accepting the medal Mr. McGraw discussed some of the broader aspects of the part which advertising is playing in the development of American industry and the maintenance of prosperity, with particular reference to present business conditions. He said in part:

"At present the volume of trade is large. But competition is throttling and profits in some quarters are declining. Some industries are despairing of customers. Has advertising, now so generally used, proved ineffective in maintaining full prosperity? Advertising has won its spurs in the economical movement of distinctive goods, with resultant public gain. Is it not the greater field of staples or 'near staples' to which advertising must now be more widely applied, both in the industrial and consumer fields? And may not we here find a tonic for the price competition malady, thus aiding to restore complete industrial health?

"In considering the broader as well as the more effective use of advertising, it may well be questioned whether any product, however staple at first sight it may appear, is without elements of distinction. A product is endowed with the qualities of its makers, and no organization is entirely devoid of personality. The very fact of survival in a competitive market is proof that there is distinctiveness in product or service. There are a hundred respects in which firms differ from each other. All these affect the willingness of the buyer to take one manufacturer's product rather than another's, even though the products appear to be similar. We must increase our knowledge of how to sense these elements of distinctiveness in this great field of the staple product. Then we shall open up new vistas of advertising effort. Then we shall transfer many products from the miasma of excessive price competition to the high free air of competition in quality and service. Then we shall trade up, rather than down. And business will be the healthier for it.

"It is apparent that the very planning of advertising causes a most searching examination of products, to determine the distinctive elements. If, perchance, there be no market distinction, then, at the very least, advertising may guarantee a continuance of quality. The market position of certain brands of flour, bread, soap, cement, brass, industrial belting—the prosperity attending their makers—is eloquent testimony of advertising's effectiveness in the staple field. It has endowed run-of-product with a special character, and, through the guarantee of sustained quality, advertising has made specialties within staples.



JAMES H. MCGRAW

"True, advertising does not confer full immunity from price considerations and consequent narrow profits and halting markets, but it does shift the competition to bases of quality and use. It puts the battle on the seller's rather than the buyer's ground, but at the same time it proves a boon to the buyer because of insistence on quality. The slogan 'Quality is remembered long after price is forgotten,' already accepted as a principle by industrial consumers, suggests distinct social advantages to consumers at large. Why, then, has not advertising been more completely adopted by business? Why is there today some mistrust of advertising and often lack of will to invoke its power to help correct the current business situation?

"Advertising failures have resulted less from lapses in advertising technique than from advertising misapplied. Advertising cannot create qualities. Advertising cannot give market standing to a product where market value does not exist. It is sheer folly to assume that a product will take on compelling qualities if only they be claimed in advertising. Advertising can express, develop and amplify what is already present. It can stimulate the seed of product or service personality to growth and vigor. It cannot create the seed. Advertising is a challenge to soundness. It drags an institution into the limelight. It exposes it to examination and to criticism of its claims. For businesses with productions that match the needs of the times advertising is a beneficent instrument; for those with products that have no rightful market claim advertising is either corrective or fatal. And to soundness of product or service there must be added soundness of marketing method, if advertising is to be an effective instrument of prosperity.

"Distribution costs are being subpœnaed before the court of public opinion, and too often advertising has had to bear the unjust odium of marketing's shortcomings. The logical markets may have been wrongly appraised. Distribution was attempted under conditions that made the cost prohibitive. Difference in buying habits, according to fields or industries, has been overlooked. Appeals to buyers have not been valid. Distribution channels have not been effectively organized. The sales force has been inadequate, ineffective or mishandled. Yet of advertising is expected the impossible delivery of economical distribution. It is to the credit of many advertising men that they have been among the leaders in the adoption of modern marketing methods and that, in large number, they are competent counselors on marketing plans.

"We can look with great hope on advertising's promise for the maintenance of prosperity. Advertising has an important rôle in widening the profit margin in both industrial and consumer transactions. It removes products from unhealthy price competition as fast as it can unearth distinctiveness in products and organizations. It reduces production costs by insistence, in the planning of campaigns, on conformity of goods to needs and on standardization and simplification. It reduces distribution costs by challenging unsound marketing programs. Proved to be an effective instrument in marketing specialties, advertising is now entering the even larger arena where staples are battling before a price-obsessed public. It offers new weapons of quality and service in business' struggle with meager profits. Proved the stimulant of new public wants, advertising holds out enticing incentive to ever-faster introduction of new products."

Federal Court Restrains the Cambridge Rate Order

Judge Lowell of the United States District Court issued a restraining order on Monday of this week against the Massachusetts Department of Public Utilities in regard to enforcing its recent decision reducing the maximum price per kilowatt-hour from 8 cents to 5½ cents on the system of the Cambridge Electric Light Company. The company has filed a petition for a temporary injunction which will be before the court for hearing in about a week. Press reports current in Boston last week to the effect that the company had decided to accept the commission's finding were denied as without foundation by Frank H. Golding, general manager of the New England Gas & Electric Association, upon inquiry by the ELECTRICAL WORLD as to their authenticity.

Governor Smith's Water-Power Bill Again Up

Governor Smith's bill to set up a Water Power Authority in New York State to "conserve and control" its water-power resources and provide for the submission of a comprehensive plan to the Legislature was once more introduced at Albany last week. Senator Downing called for a "popular uprising" to bring about passage of the bill and the Governor will probably write a special message in its support. There seems, however, little doubt that, as before, the bill will get nowhere against a hostile legislative body.

Consumers Power-Detroit Edison Interconnection a Fact

On Thursday of this week throwing a switch at Jackson, Mich., tied in the high-tension systems of the Consumers Power Company and the Detroit Edison Company. The interconnecting link, work on which was begun a year ago, will operate at 132 kv. From a new substation of the Detroit Edison Company near Ypsilanti, which contains three 15,000-kva. transformers, a steel-tower transmission line carrying a three-phase copper circuit runs 42 miles to a joint substation at Cement City, south of Jackson. A like transmission line, 18 miles long, runs from a new Consumers Power substation north of Jackson, containing three 10,000-kva. transformers, to the joint station at Cement City. It is proposed later on to add a second circuit of like capacity.

The Consumers Power Company, which serves central, western and some eastern counties in Michigan, has a total rated capacity of about 283,000 kw. The Detroit Edison Company has about 644,000 kw. in the industrial southeastern section of the state. The interconnection will enable either company to call on the other to the extent of 37,500 kw. No formal ceremony took place on Thursday, but Alfred C. Marshall, vice-president and general manager of the Detroit Edison Company, and Charles W. Tippy, vice-president and general manager of the Consumers Power Company, met at noon at the substation north of Jackson and joined in the throwing of the switch.

Maryland Commission's Ban on Sale Upset

Remanding to the Public Service Commission of Maryland for further procedure the application of the Electric Public Utilities Company for permission to purchase four small power plants in the western part of that state, the Court of Appeals declared last week that it was not within the discretion of the commission to refuse such permission unless it was proved that the change in ownership would be detrimental to the public interest. This decree upset the decision of the Baltimore City Circuit Court (see ELECTRICAL WORLD for July 23, 1927, page 182). In remanding the application the court expressed no opinion as to its merits.

The small companies concerned are the Home Electric Company of Lonaconing, the Emmitsburg Electric Company, the Antietam Electric Light & Power Company and the Midland Electric Light Company.

Key in Fort Myers Starts Up Lights in Bellingham

Completing what is probably the longest remote-control circuit ever attempted in the United States, Thomas A. Edison, at Fort Myers, Fla., on the evening of Feb. 11, his eighty-first birthday, closed a key which actuated the switch controlling the new lighting system for the business district of Bellingham, Wash. This circuit, extending from Fort Myers to Bellingham via Washington, New York, Buffalo, Detroit, Chicago, Fargo, Butte, Spokane and Seattle, measured approximately 5,700 miles and had been set aside for the occasion by the Western Union Telegraph Company along with a second standby circuit following a different route.

Iowa Power Conference Hears of Gain in Rural Service

A continued tendency toward consolidation, a higher standard of construction for transmission lines and an encouraging attitude by the industry toward solution of rural electrification problems were outstanding features last year in the light and power industry in Iowa, according to Joe Carmichael, director of the Iowa Committee on Public Utility Information, who spoke at the second annual power conference last week at the University of Iowa, Iowa City, at which a hundred engineers and power experts gathered.

Utilization of Iowa coal in industrial power development was discussed by J. E. Everson, general superintendent of the Sioux City Gas & Electric Company. "Pulverized-coal firing puts Iowa coal, admittedly of a lower quality, on a par with any coal so far as physical results are concerned," he said.

Sidney L. Miller of the Iowa College of Commerce dwelt on the social benefit to be derived from the development of electricity because of its decentralizing influence on industry.

Purchases and Mergers

Portland Electric Power Plans to Buy Northwestern Electric — Holding Company Formed in Providence to Buy Utilities

ANNOUNCEMENT was made on Feb. 18 by Franklin T. Griffith, president of the Portland Electric Power Company, and Guy W. Talbot, president of the Northwestern Electric Company, that the Portland Electric Power Company would purchase the competing Northwestern company and make a material rate reduction, provided that the deal is sanctioned by the people of Portland at a special election which will be held in April at the expense of the two power companies. Operating economies estimated at approximately $300,000 a year resulting from the consolidation will be passed on in their entirety directly to the customers in the form of reduced rates applicable first to the domestic customer and secondly to the other classes of business.

The franchise of the Northwestern Electric Company, which expires in 1937, contains a clause prohibiting the sale of the property to a competing company without the consent of the City Council. The companies have suggested that the Council submit to the voters an ordinance permitting the consolidation. Promised domestic rate reductions will be made public before the people are asked to vote on the merger. The Northwestern Electric Company, purchased by the American Power & Light Company from the Fleischhacker interests in 1926, is valued at $23,000,000, and E. W. Clark & Company of Philadelphia now hold the controlling interest in the Portland Electric Power Company property, valued at $81,000,000. The joint properties have a combined steam and hydro generating capacity of 232,000 hp. and approximately a hundred and forty thousand customers.

The recent formation of a four-million-dollar holding company, the New England Water, Light & Power Company, to acquire public utility properties in different parts of New England, was announced last week at Providence by Arthur B. Lisle, former vice-president and general manager of the Narragansett Electric Lighting Company, who is heading the new firm, which will have headquarters in the Rhode Island capital. The companies so far acquired are mainly water companies, but the Central Connecticut Power & Light Company, East Hampton, Conn., is included.

Proposed operation of the Charlemont (Mass.) Electric Light & Power Com-

pany as a municipal plant by the town of Charlemont was defeated by a vote of 70 to 55 at the annual town meeting recently.

The Foshay interests in Vermont are to take over the Nichols company, operating in Barton.

The Low Power & Light Corporation has made application to the New York Public Service Commission to lease to the village of Tupper Lake the power plants in Colton and Piercefield, and the village of Tupper Lake has asked for authority to do a general business in Colton, Piercefield and Altamont.

Public hearings on the application of the Potomac-Edison Power Company to absorb four smaller companies in western Maryland were to be held Feb. 24 by the Maryland Public Service Commission. Little opposition was expected, if any. The four companies to be absorbed are the Ridgeley Light & Power Company, the Piedmont Electric Light & Power Company, the Potomac Light & Power Company and the Clearspring Electric Light & Power Company.

Cortland, Ohio, plans to sell its municipal lighting system to the Ohio Public Service Company, and preliminary legislation has been passed by the Council.

Authority has been granted by the Illinois Commerce Commission to the Illinois Power & Light Corporation to purchase the Orvil Light, Power & Water Company at Hartsburg for $26,150. The commission denied permission to purchase the Arenzville Light & Power Company, Prather & Hill Electric Company and Elkhart Electric Light Company.

The Illinois Power & Light Corporation has applied to the Illinois Commerce Commission for authority to acquire the Secor Light & Power Company.

Petition to purchase the Dillsboro (Ind.) Electric Company for $23,500 has been filed with the Indiana Public Service Commission by the Interstate Public Service Company.

The City Council of Onida, S. D., has called a special election for Feb. 28 to vote upon selling the municipal lighting plant to the Northern Power & Light Company, of Mobridge, S. D., for $22,600.

In answer to the Northern States Power Company, which wished to buy the city-owned electric plant at Moorhead, Minn., the Council says the system is not for sale.

The Minnesota Hydro-Electric Company, operating in the northern part of Minnesota, has been sold to the Northwestern Utilities Company of Minneapolis. The purchased company has been combined with four others owned by the Northwestern Utilities in Minnesota and Wisconsin.

The Northern States Power Company is negotiating with the Lakefield (Minn.) Town Council for purchase of its municipal electric plant.

Because officials of the city of Stafford, Kan., fear that rates of the municipally owned electric plant would have to be raised if a sister city, Sylvia, sells its distribution system to the United Power & Light Corporation, Stafford has entered objections with the State Public Service Commission. It is understood that the company desires to acquire the right to serve both towns.

Negotiations have been completed by the Central Kansas Power Company, with headquarters at Hays, for the purchase of the municipal electric light and power plant at Atwood, Kan., it is announced by Ross Beach, manager of the power company.

College View, Neb., a suburb of Lincoln, has defeated a proposal to sell its light and power plant to the Iowa-Nebraska Light & Power Company. The vote was 513 to 366.

The Western Light & Power Company of Salina, Kan., is reported to have offered $200,000 for the municipal lighting plant of Caldwell, in that state.

The Oklahoma Power & Water Company, newly incorporated in Delaware, has received authority from the Corporation Commission of Oklahoma to take over the Sand Springs Light & Power Company, the Sand Springs Home (supplying electricity), the Bigheart Light & Power Company, the Cimarron Light & Power Company and the Eastern Oklahoma Light & Power Company. Cities affected by the change are Sand Springs, Sperry, Skiatook and seventeen others.

Permission to merge the Kansas City Power Securities Corporation with the Continental Gas & Electric Company is being sought from the Missouri Public Service Commission. The Power Securities Company is the local holding company for the Kansas City Power & Light Company. The Continental Gas & Electric owns the common stock of the Power Securities.

Application has been filed with the Missouri Public Service Commission by the National Utilities Company, with headquarters at Brookfield, Mo., for authorization to purchase the Kirksville Gas, Heating & Electric Company and the Brookfield Gas, Electric & Heating Company.

Sale of the Rockport (Mo.) Light & Power Company by W. F. Marshall and O. W. Clifton to a new corporation to bear the same name has been authorized.

Purchase of the electric distribution system of Chula, Mo., by the Missouri Public Service Company is announced.

Sale of the city light plant at Benton, Ark., to the Couch interests will probably be an issue in the April city election.

The Arkansas Power & Light Company has purchased the lighting plant of Yellville, Ark., supplying power and light to Yellville and Summit.

Announcement is made by the Oklahoma Gas & Electric Company that the city of Drummond has voted to sell its municipally operated distribution system to that company.

The Carolina Power & Light Company, Raleigh, N. C., has bought the South Carolina Power & Light Company, serving Kingstree, Manning, Lake City and other places in South Carolina.

The East Coast Utilities Corporation, owned by Chicago interests, has in recent months acquired small plants in Waverly, Irvington, Kilmarnock, White Stone, Colonial Beach and other towns in eastern Virginia. The company is building a small generating plant at Port Richmond, near West Point, to furnish light and power to West Point, Saluda, Urbanna and other points in that section.

The Stuart (Va.) Light & Power Company has been sold to J. F. Reynolds and J. F. Reynolds, Jr.

A movement is on foot to sell the municipal electric light plant at Athens, Ala., to the Alabama Power Company.

Reports are current in Austin, Tex., that that city is considering the sale of its light and power plant to the Texas-Louisiana Power Company of Fort Worth.

A resolution for the sale of the municipal lighting plant to the Florida Public Service Company for $82,000 has passed the Mount Dora (Fla.) City Council.

A unification agreement has been signed by the Capital Traction Company, the Washington Railway & Electric Company and Harley P. Wilson, the owner of 21,237 shares of the stock of the Washington Rapid Transit Company, by which a new company, to be known as the Capital Transit Company, will be formed to operate the street railways and bus lines which the three companies are now operating in the District of Columbia and nearby regions. The plan must be approved by the Public Service Commission and by Congress. The street-railway business of the Washington Railway & Electric Company will be taken over, but the power business of the company will be continued as a separate entity, with the agreement that power is to be furnished the new company at reasonable rates.

Seeking to relieve the complications of the corporate set-up of its subsidiaries, the Consolidated Gas, Electric Light & Power Company of Baltimore has just filed with the Maryland Public Service Commission an application to acquire the properties and assets of the concerns in entirety. These subsidiaries are twelve in number. They include the Mount Washington Electric Light & Power Company and the Patapsco Electric & Manufacturing Company of Delaware.

Announcement has been made of the acquisition by the Canadian Hydro-Electric Corporation, a subsidiary of the International Paper Company, of the properties and assets of the Ottawa & Hull Power Company and its subsidiary, the Ottawa River Power Company, which serve the cities of Ottawa and Hull. This means that almost entire control has been obtained by the International Paper interests of all power developments in the Ottawa and Gatineau districts. The Power Corporation of Canada held the majority of the shares of the Ottawa & Hull Power Company.

Kinston, N. C., and Municipal Ownership in That State

As previously reported, several bids for the Kinston (N. C.) municipal plant of approximately three times its cost have put that community of 12,000 souls on the electrical map and aroused intense interest among its inhabitants. (ELECTRICAL WORLD, Feb. 18, page 370.) The matter will furnish the chief issue in the next municipal election. Backers of the proposal accepted by the City Council to sell the plant to the Carolina Gas & Electric Company for $1,271,000 will have to fight to bring a majority of the voters to their viewpoint. There is strong opposition, despite the fact that Robert A. Blackwood, head of the company, lives at Kinston and that the company has its headquarters there. One element of the voters believes that the still higher Gregory-Livingston bid should have been accepted. Another element opposes a sale to any group. Still others would have new bids called for or have the property turned over to the Carolina Power & Light Company. Though the Carolina's offer was considerably lower than the others, that company had a large following which believed it would "do more for Kinston" than either of the others.

City officials at Greenville, Washington, New Bern and other towns in the eastern half of the state that have municipal plants are watching the Kinston situation, and the outcome will be influential in strengthening or weakening the opposition that has been manifested in North Carolina towns to disposing of their plants to private companies.

Oppose Plan of Regulation by Contract

Massachusetts Utility Companies Assail Commission Bill Now Before Legislative Committee — Professor Cabot Defends Reproduction Cost as Rate Base

A BATTLE royal between the Massachusetts Department of Public Utilities and the light and power companies represented in the Massachusetts Gas and Electric Association began last week at Boston over the regulating commission's bill providing for legislation under which companies would be penalized by non-consent to regulation by agreement along the lines reviewed in the ELECTRICAL WORLD for Dec. 17 (page 1265). At the opening of an all-day hearing before the legislative committee on power and light, Chairman H. C. Attwill of the Massachusetts commission set forth the board's bill as an opportunity for electric and gas companies to readjust their capital and carry on their future business under a regulative contract with the state which would safeguard their securities and insure protection of consumers against exploitation either by local managements or by outside controlling groups. He excoriated the policy of resisting rate reductions ordered by the commission, as in the case of the Worcester Electric Light Company, and declared that unless regulation of privately managed utilities is assured, municipal ownership will follow.

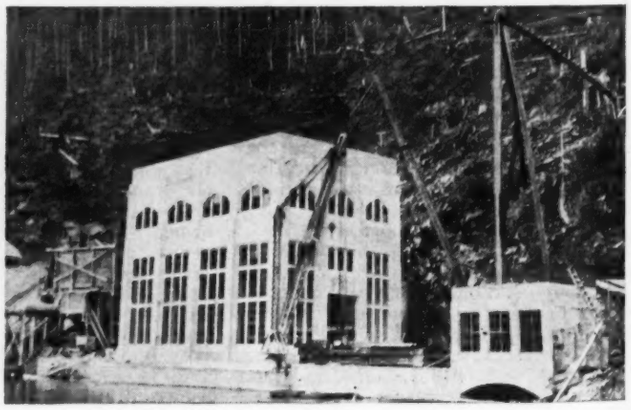
For the power companies, Sheldon E. Wardwell took the ground that the bill of the commission is revolutionary in character, threatening the stability of the industry by its new and untried expedients and by its requirement that companies accepting it abandon their right of appeal to the courts. He maintained that it would virtually wipe out the surpluses of many companies and cut down their proper rate bases, drying up the wells of fresh capital supply and stultifying the industry's development. The agreement proposes to furnish a fair return to the investor on his "desiccated" investment, but the future investor will not accept a risk where there is no constitutional protection. The promise to keep the stocks at par is ephemeral, the speaker declared, and in times of economic stress the financial burden would be transferred wholly from the investor to the rate payer.

Prof. Philip Cabot, head of the public utility courses of the Harvard Graduate School of Business Administration, analyzed the commission's bill from the economic standpoint and maintained that its objective—obtaining a necessary service for consumers at the lowest possible price — cannot be attained through this agency. He reasoned that the application of the bill would tend to create inflation in the long run, followed by increased rates at times when decreases are in order and increased severity of the business cycle. The rigid rate base chained to the dollar he held to be artificial and very dangerous.

Vigorous opposition to the bill was voiced at a second hearing by B. Loring Young on behalf of the Associated Industries of Massachusetts; F. W. Denis, vice-president Old Colony Trust Company, Boston; H. P. Gifford, president Savings Bank Association of Massachusetts and of the National Association of Mutual Savings Banks; Fitzhewey Smith, Massachusetts Bankers' Association, and Arthur W. Wood, investment banker, Boston.

Mr. Young contended that the business interests of the state are gravely concerned lest the bill impair the ability of the power companies to meet the expanding demands of industry for power. Other points made against the bill were its alleged unconstitutionality, the difficulty of maintaining stocks at or near par by commission action, the premium put on extravagance of management, liability of higher rates, and lack of provision for an emergency requiring drastic remedies. Chairman Attwill and Commissioner Wells defended the bill, urging that its opponents misinterpret its intent and exaggerate its effect on the stability of regulative practice in Massachusetts. The hearing was adjourned until this week for further rebuttals to be presented.

Two Recently Built Canadian Automatic Hydro Stations



STEADY increase in demand upon the Georgian Bay System of the Hydro-Electric Power Commission of Ontario has led to the recent completion of an automatic plant at Hanna Chute on the Muskoka River. This station, which is in a district lying north of the territory served from Niagara Falls, is operated by remote control from the South Falls generating station, half a mile below. The Hanna Chute station, built in a narrow rock gorge, is of pressed-brick construction and houses one vertical-type, three-phase, 60-cycle, 6,600-volt generator with a rated capacity of 1,400 kva. at 80 per cent power factor, operating at 225 r.p.m. The lubrication system is self-contained. No step-up transformers are provided at this plant, the station feeding direct to the South Falls station.

The exterior of the Alouette power plant of the British Columbia Electric Railway Company, shown on the right, has recently been finished. It is built on Stave Lake, 12 miles above the present Stave Lake plant, from which it will be automatically operated. Rated at 10,000 kva., the Alouette plant, which cost $2,300,000, will add almost 13,000 hp. to the present capacity of the company, and is therefore among the largest of its description. The Alouette chain of lakes lies at an elevation of 370 ft. above sea level, 25 miles east of Vancover. They have a drainage area of 80 square miles with a dependable flow for power purposes of 700 cu.ft. per second, which is 90.2 per cent of the mean flow.

The development consisted of raising the lakes approximately 50 ft. by means of a semi-hydraulic earth-filled dam with separate concrete-lined spillway and an overflow weir and control crest gates set in the spillway at the north end of the dam. At the upstream end of the lake, which is 10 miles away from the dam, a 12-ft. by 16-ft. tunnel has been driven through the narrow ridge to Stave Lake, a distance of 3,500 ft. The water is discharged through this tunnel to the power plant at an average head of 132 ft., the flow and generation of 12,500 hp. being controlled at Stave Lake power plant.

National Speakers Engaged for Tulsa Convention

The program of the tenth annual convention of the Oklahoma Utilities Association, to be held at Tulsa, March 13 to 15, will contain many national convention features, according to E. F. McKay, manager of the association. Among its features will be an illustrated review of the outstanding developments in electricity in 1927 by John D. Liston, General Electric Company; a discussion of relations between the newspapers and the utilities of Oklahoma by N. A. Nichols, secretary Oklahoma Editorial Association; a review of the year and a forecast of the future in public relations by J. F. Owens, vice-president Oklahoma Gas & Electric Company; an address on interstate phases of electric power development by H. S. Bennion, director of engineering, N.E.L.A., and a statement of progress toward elimination of drudgery in the home by Miss Eloise Davison of the headquarters N.E.L.A. staff. Representative Charles A. Eaton will speak at the banquet.

The Electrical Division program, March 13 and 14, will include: "Developing Power Load in the Oil Fields," O. A. Jennings, Oklahoma Gas & Electric Company; "Rural Electrification," Edwin Kurtz, chairman Oklahoma Farm Electrification Committee; "Refrigeration," R. W. Curran, Bartlesville Gas & Electric Company; "Rural-Line Construction Standards," L. H. Reagan, Southwestern Light & Power Company; "Developing the Small Industrial Load," S. I. McElhoes, Southwestern Light & Power Company; "Safety Methods and Accident Prevention," C. H. Meyer, Public Service Company of Oklahoma, and "Developments in Commercial Lighting," A. E. Warner, Oklahoma Gas & Electric Company.

Applications Before Federal Power Commission

G. S. Howe of East Radford, Va., has applied to the Federal Power Commission for a preliminary permit covering a 12,000-hp. project on New River near East Radford. It is proposed to construct a dam 50 ft. high in New River which will create a reservoir extending up stream to Plum Creek, a distance of 12 miles.

The Board of Directors of State Institutions of Arizona has applied for a preliminary permit for a project on the Colorado River, the site being at Grand Wash Canyon, Mohave County. The project involves the regulation and storage of water for irrigation and power, which will be used for public utility purposes.

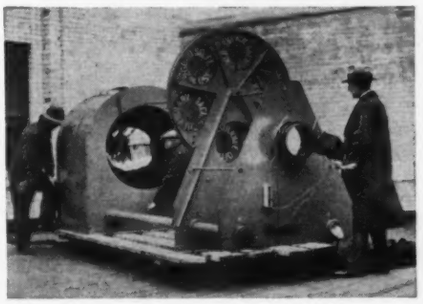
Anita M. Baldwin of Los Angeles has applied for a license to cover the replacing of a timber dam at an existing project on Taylor Creek in El Dorado County, Calif., with a concrete structure. The new dam is to be 10 ft. high and 450 ft. long. Only 150 hp. is involved.

Briefer News

PROGRESS ON OSWEGO RIVER PLANT.—Nearly all construction work on the power plant of the Oswego River Power Corporation, at Dam 6 in the Oswego River, in New York State, is finished. Waterwheels have been set and electrical equipment is now being installed. The plant will go into operation early in the spring, it is thought.

SPRINGFIELD (MASS.) COMPANY CUTS RATES.—Directors of the United Electric Light Company, Springfield, Mass., last week voted to reduce rates from 7 cents to 6 cents a kilowatt-hour for domestic consumers using less than 200 hours a month and to 5 cents if more than 200 kw.-hr. is used. For refrigerators and ranges on a separate meter 4 cents will be the rate.

GERMAN CLOUD-ADVERTISING MACHINE DEMONSTRATED.—An imported machine from the shops of Carl Zeiss, a German maker of photographic appa-



ratus and lenses, is here shown on the roof of the Salmon Towers Building in New York. It is designed for casting advertisements on the clouds by means of a searchlamp shining through stenciled dies which rotate with a larger disk. The night must be cloudy to make the instrument of value, as the projected message must have a background to give it material form.

LOS ANGELES GAS & ELECTRIC WANTS ORNAMENTAL STREET-LIGHTING BUSINESS.—Making a determined effort to get a share of the rapidly increasing ornamental street-lighting business of Los Angeles, the Los Angeles Gas & Electric Corporation on Feb. 9 announced 25 per cent reduction in rates on electricity used for this purpose. The present rate, 4 cents a kilowatt-hour, will be cut to 3 cents, effective March 1. The company's engineers declare the new rate will allow an 8 per cent return on investment.

CINCINNATI IN QUANDARY OVER LIGHTING ITS NEW BOULEVARD.—Cincinnati is confronted with the probability that its new Central Parkway will be unlighted throughout the spring and summer. This has just been revealed by the definite announcement of the Rapid Transit Commission of the municipality that it was not authorized to do more than to construct the parkway. The commission has bought and installed light standards and traffic signals, but has no legal authority to contract for energy and maintenance. The parkway is the city's most important boulevard.

VIRGINIA ELECTRIC & POWER TAKES LOAD OF MARINE CORPS POST.—Quantico, Va., and the United States Marine Corps post there have been placed on the main transmission system of the Virginia Electric & Power Company, according to William E. Wood, president. The company has completed a 27-mile extension of its 66-kv. line from Fredericksburg to Quantico and the construction of a modern all-steel substation at the Quantico terminus. The Marine Corps post previously has been served by its own power plant.

A.I.E.E. REGIONAL MEETING PROGRAMS.—For the regional meeting to be held at Baltimore on April 17-19 three technical sessions are planned on the subjects of insulation, the Gould Street station of the Consolidated Gas, Electric Light & Power Company and the Conowingo development of the Philadelphia Electric Company respectively. The proper application of relays and the instruments and methods used in determining it will be topics at the New Haven regional meeting, scheduled for May 9-11.

IMPROVEMENT PROGRAM FOR MICHIGAN'S CAPITAL.—Of the large sum appriated for extensions to be made this year to the Consumers Power Company's system in Michigan, more than a million dollars will be spent on improvements in the Lansing district, according to Clark R. Graves, district manager. Service will be extended to Howell and towns en route; a substation will be erected in Delhi township, about 3 miles south of Lansing, and the completion of transmission lines connecting Lansing with Jackson, Battle Creek, Flint, Owosso and Ann Arbor will insure uninterrupted service.

SYNDICATE POWER COMPANY AND WEST TEXAS OBJECTORS REACH AGREEMENT.—As a result of settlement of the controversy between the Insull interests and the West Texas Chamber of Commerce over the appropriation of water rights on the Colorado River, the Syndicate Power Company will immediately start its program for the construction of a series of dams and hydro-electric plants on that stream, according to reports said to emanate from the power company. The initial expenditure will be $1,000,000 and may be made before the end of this year in the purchase of equipment. An ultimate expenditure of $25,000,000 is envisaged. The Syndicate Power Company holds permits to build six dams and hydro-electric plants in the Colorado River, two in Travis County and four in Burnet County. Under the terms of the agreement the

Syndicate Power Company agrees to surrender all but 580,000 acre-feet of water annually of its legal rights to 1,225,000 acre-feet of the Colorado River, together with the waiver from south Texas rice growers to water above the proposed Hamilton dam in Burnet and Llano Counties.

ANOTHER EEL RIVER PLANT PROJECTED IN CALIFORNIA.—The Snow Mountain Water & Power Corporation has obtained a permit from the California Department of Public Works to appropriate 400 sec.-ft. and 214,813 acre-ft. per annum from the South Eel River in Lake County for power purposes. The corporation plans to develop about 22,000 hp. at an estimated cost of $3,200,000, in addition to the output of its present power plant, which is supplied by water from the South Fork of the Eel River.

RICE GROWERS BENEFIT FROM INDUSTRIAL ELECTRIFICATION IN ARKANSAS.—Coming reduction in rates for electric service to rice growers is announced by Frank M. Wilkes, general manager of the Arkansas Power & Light Company. The new rates will, it is expected, save between 15 and 30 per cent, depending upon the rainfall and the amount of energy used during the pumping season. The reduction was made possible by the steady increase in the industrial power business of the company due to the establishment in Arkansas of additional mills and substitution of electric service for other power by long-established industries. Many additional rice farmers are planning to avail themselves of electricity in their homes as well as on their fields.

ROCHESTER'S GAIN FROM ADDED WATER POWER.—Installation of a 23,000-hp. hydro-electric unit at Station 5 in the Rochester Gas & Electric Corporation's Genesee River power development at Rochester has enabled the company to generate an additional 16,000,000 kw.-hr. from the river flow and resulted in a saving of 16,000 tons of coal since October, according to Thomas H. Yawger, superintendent of the company's electric department. The new unit has enabled the company to take advantage of the flow which ordinarily would have gone over the dam during the last three and one-half months. Repairs completed last week on the break in the State Barge Canal near Holley also gave the utility company the advantage of added water power.

PACIFIC GAS & ELECTRIC RATE REDUCTIONS WILL SAVE CONSUMERS $1,600,000 A YEAR.—Through the voluntary reduction of electric lighting rates to domestic and commercial consumers served by the Pacific Gas & Electric Company a saving of $1,600,000 on their yearly bills will be effected, the company says. New schedules are now being prepared, and the reduced rates are expected to go into effect in March. They will apply to the cities and towns of all P. G. & E. territory except that recently acquired through purchase of the properties of the Western States Gas & Electric Company and the Coast Valleys Electric Company. Under the new plan the minimum charge of 90 cents will be abolished, and in its place there will be a 5-cent kilowatt-hour rate plus a small service charge. To the small consumer this will mean a saving of approximately 10 per cent. The Great Western Power Company is also to reduce its rates, a total saving of about $500,000 being the estimate.

CONSTRUCTION OF STEVENS POINT-GREEN BAY LINE BEGUN.—Preliminary survey work on the new 110-kv. tie-in line from the Bayside steam plant of Wisconsin Public Service Corporation to the Wisconsin Valley Electric Company's lines at Stevens Point has been completed and construction begun. The line will enable the cities in the Wisconsin valley to get the benefit of the lower prices of coal brought to the Green Bay docks via the Great Lakes and in turn will enable Green Bay and other eastern Wisconsin cities to profit by the use of power from the hydro plants in the Wisconsin valley in times of high water.

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of every volume. For latest list see ELECTRICAL WORLD for Jan. 7, page 80.]

New England Central Station Association of Power Engineers—Engineers' Club, Boston, Feb. 29. T. D. Bond, C. H. Tenney & Co., Boston.

American Institute of Electrical Engineers—St. Louis regional meeting, March 7-9; Baltimore regional meeting, April 17-19; New Haven regional meeting, May 9-11. F. L. Hutchinson, 33 West 39th St., New York.

Northwest Electric Light and Power Association — Engineering Section, Spokane, Wash., March 8 and 9. Berkeley Snow, 1208 Spalding Building, Portland, Ore.

Oklahoma Utilities Association—Mayo Hotel, Tulsa, March 13-15. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

Illinois State Electric Association—Hotel Abraham Lincoln, March 14-15. R. V. Prather, 205 Illinois Mine Workers' Bldg., Springfield, Ill.

National Electrical Manufacturers' Association—Policies Division, Edgewater Beach Hotel, Chicago, March 14-16. S. N. Clarkson, 420 Lexington Ave., New York.

International Association of Electrical Inspectors—Madison, Wis., March 17-18. W. Wilke, 4211 Eiring Place, Milwaukee.

Maryland Utilities Association—Emerson Hotel, Baltimore, March 23. G. S. Williams, 1005 Continental Bldg., Baltimore.

Southwestern Division, N.E.L.A. — Edgewater Gulf Hotel, Biloxi, Miss., April 3-5. S. J. Ballinger, San Antonio Public Service Company, San Antonio, Tex.

Nebraska Section, N. E. L. A.—Omaha, April 4 and 5. T. E. Browne, 1527 Sharpe Bldg., Lincoln.

Southeastern Division, N. E. L. A.—Miami, Fla., April 11-14. C. M. Kilian, 207 Bona Allen Bldg., Atlanta.

American Electrochemical Society—Bridgeport, Conn., April 26-28. C. G. Fink, Columbia University, New York.

Missouri Association of Public Utilities—Jefferson City, April 26-28. F. D. Beardslee, 315 North Twelfth St., St. Louis.

Southwestern Public Service Association—Dallas, Tex., May 2-5. E. N. Willis, 403 Slaughter Bldg., Dallas.

Middle West Division, N.E.L.A.—Hotel Statler, St. Louis, May 9-11. T. A. Browne, 1519 O St., Lincoln, Neb.

FIRST RURAL ELECTRIC DISTRICT UNDER NEW NEBRASKA LAW PLANNED.—The directors of the Gering Valley (Neb.) Hydro-Electric Light and Power District have sold the $80,000 in bonds, subject to ratification by the voters on March 13, to a Denver house. The district, if established, will be the first under the new law intended to aid in rural electrification. It will serve sugar-beet growers owning 33,000 acres. The municipal plant at Gering, Wyo., which buys from the government reclamation dam at Guernsey, will supply the energy.

CANADA MAY SET UP ELECTRICAL TESTING BUREAU.—The Dominion government is asking Parliament to sanction the creation of a Canadian Bureau of Standards, including the appointment of a director and the provision of facilities for the testing of electrical equipment and appliances of all kinds. Consent and co-operation of the provinces have already been obtained. Canadian and British manufacturers have made urgent representations to the government favoring such a bureau. Their products hitherto have been subject to the approval of United States laboratories in order to satisfy the fire underwriters.

FOR IMPROVEMENT OF NEW ORLEANS' STREET LIGHTING.—Latest methods of street lighting in Chicago, New York, Detroit, Cleveland, Boston, Toledo, Milwaukee, Indianapolis, St. Louis and other Northern and Eastern cities have been studied by William T. Hall, commissioner of public utilities, New Orleans; Walter Dilzell, city electrician, and Frank Frost, general superintendent of the electric department, New Orleans Public Service, Inc. As the result of their tour Messrs. Hall and Dilzell will work out a new plan of street lighting for New Orleans. It is probable that this plan will include the installation of ornamental steel poles along Canal Street from the river to Claiborne Avenue, each pole carrying two 1,500-cp. lights with the poles 100 ft. apart. The present street-lighting contract will expire in April.

TENNESSEE EASTERN ELECTRIC SEEKS TO ENJOIN STATE COMMISSION.—Involving issues of vital importance to the hydro-electric industry of the United States and to public utilities in general, the injunction suit of the Tennessee Eastern Electric Company against the Railroad and Public Utilities Commission of Tennessee has begun in the Chancery Court at Nashville. Flat denial of the legal right of the commission to exercise the power of control it claims over water-power development, or to impose a tax of one mill per kilo-

watt-hour produced, is made by the company, and even the authority of the Federal Power Commission is called into question in some of the issues. In its answer the Tennessee commission declares that the record of the company, in its dealings with the commission, has been one of "misrepresentation, duplicity, fraud and deceit." The commission demurs to the bill on fifteen separate grounds. The Holston River Power Company, named as a second defendant in the suit, likewise demurs to the bill and claims the petitioner is seeking to dam a navigable stream without obtaining federal permission. Decision was deferred by the court.

KANSAS ELECTRIC POWER CUTS RATES HEAVILY. — Voluntary rate reductions of 20 to 25 per cent for average domestic consumers throughout the territory served by the Kansas Electric Power Company, with headquarters at Lawrence, have been approved by the Kansas Public Service Commission. Such reductions, affecting 30 cities and towns, will go into effect in June. These decreases are probably the largest and most widespread to be made by one Kansas company for several years. The reductions have a bearing on the announced purpose of the state commission last fall to bring about a greater uniformity in electric rates in Kansas. At that time, acting on recommendations of John H. Fletcher, chief engineer for the commission, that body indicated that unless other electric companies voluntarily lowered rates to conform more closely to those of the Kansas Gas & Electric Company of Wichita, the commission would proceed to require a leveling of rates, and it has since then been taking steps to achieve that object. The Wichita concern has a uniform rate in all 64 towns in its territory, irrespective of size.

LATEST GEOLOGICAL SURVEY REPORT ON UMPQUA RIVER. — The Umpqua River basin in southwestern Oregon possesses huge potential power resources. They exceed those of any one of more than half of the states, according to a statement just issued by the Department of the Interior through the Geological Survey. There is, however, but one small developed site in the basin, on North Umpqua River near Roseburg, where a plant of 1,900 hp. has been built. A permit to investigate power sites at Rock Creek, Boundary, Toketee Falls and Lemolo Falls, on the North Umpqua River, and one on Clearwater River has been issued by the Federal Power Commission. Twenty-two power sites are proposed by the Geological Survey for the Umpqua and North Umpqua Rivers, fifteen power sites for the South Umpqua River and Fish Lake Creek and eleven power sites for tributaries. The total potential power of the Umpqua River basin without storage is 247,000 hp. for 90 per cent of the time and 584,000 hp. for 50 per cent. With storage these figures can be increased to 369,000 hp. and 561,000 hp. With unified operation the low figure could be increased to 400,000 hp., of which 350,000 hp. would be developed on the Umpqua and North Umpqua.

HIGH-TENSION LINE FROM FORT WAYNE, IND., TO MARION, MUNCIE AND KOKOMO.—A double-circuit 132-kv. transmission line will, it is announced, soon be built from Fort Wayne to Marion, Ind., a distance of 58 miles, by the Indiana General Service Company, at a cost of $2,500,000. At Marion the line will be divided, one double circuit going 28 miles to Muncie and the other extending 26 miles to Kokomo. At Marion a 20,000-kw. switching and stepdown substation will be built, while at Muncie there will be one of 35,000 kw. capacity. The company does not expect to shut down its plants in either city, O. M. Drischel, general manager at Marion, says. This line will join Muncie to the interconnected system of the American Gas & Electric Company.

Recent Court Decisions

ORDINANCE REQUIRING OPERATORS OF MOTOR-DRIVEN MACHINES TO BE LICENSED AS STEAM ENGINEERS FOUND VOID.—A New York City ordinance adopted in 1921 requiring operatives on machines driven by electric power to pass examinations and be licensed as steam engineers was declared unconstitutional and void in a decision by the State Supreme Court rendered in injunction suits brought by the Ice Service Corporation and others, together with two employees representing workers in the several companies. It was contended that the operatives prior to the passage of the ordinance had efficiently operated machines driven by electricity, but, not being trained steam engineers, were barred from continuing such work, though it did not require engineering experience or training.

ORDER OF COMMISSION GOVERNING HEIGHT OF TRANSMISSION LINE APPLIED TO EXISTING AS WELL AS FUTURE LINES. —Howell vs. San Joaquin Light & Power Corporation was a suit to recover damages for the death of a man who raised a water pipe perpendicularly to clean it and was killed by its making contact with a line carrying voltages as high as 17,000 and having only about 19 ft. clearance over the farm land where the man was working. A finding for the plaintiff on the ground of negligence was sustained by the District Court of Appeals in California. The line had been originally erected at a height of 23 ft. but had sagged 4 ft. It had been erected previous to an order of the California Railroad Commission fixing 25 ft. as the proper minimum height for such lines, but the court held that this order, though it had no retroactive effect, applied to lines existing at the time it was made as well as to new lines, and that the company's failure to maintain the line in question at the ordered clearance was negligence *per se* and properly submitted to the jury, along with the question of contributory negligence by the deceased. (261 Pac. 1107.)*

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

READY-TO-SERVE CHARGE BASED ON NUMBER OF ROOMS NOT DISCRIMINATORY. —The Public Service Commission of Pennsylvania dismissed a complaint brought against the Northern Pennsylvania Power Company based upon an alleged discrimination resulting from the fact that the company's tariff included a ready-to-serve charge computed according to the number of rooms served. The company showed that of the 2,058 residential or domestic consumers in the district to which this schedule applies, 1,099, or 53 per cent, would be benefited by taking service under it. Those who chose to do so could continue under the old schedule, receiving service as heretofore and having the option of changing to the other schedule should they so alter the manner of use to make the change advantageous to themselves.

"ROOM RATES" NOT APPLICABLE TO SMALL VILLAGE. — The North Dakota Board of Railroad Commissioners in fixing electric rates for the Farmers' Elevator Company, which operates an electric utility in connection with its elevator, said: "The schedule of rates now in effect, which is based upon the so-called 'room-rate' schedule, is not readily understood and, in our opinion, a more simple schedule would result in less conflict. While the room-rate schedule may be practicable in a city the size of Fargo, we doubt the wisdom of adopting such a schedule in a village with a population of 200. It is our recommendation that the Farmers' Elevator Company file with the commission within 30 days a rate schedule constructed upon a kilowatt-hour-per-month basis. . . . We will also require the company to install a system of accounting which will more clearly show the actual operating expenses of the electric utility as distinguished from the operations of the company as a whole."

'ROOM RATE" DEMAND CHARGES UPHELD.—A "room-rate" demand charge of an electric utility was said by the New Jersey Board of Public Utility Commissioners, in adjudicating a complaint listed as Sullivan vs. Rockland Electric Company, to be the result of an endeavor by the electric utility to measure the demand element in the cost of operation by some simple and easily understood rule and to distribute the cost of extra equipment used during peak demands equitably among such consumers as made the most use of such equipment. In dismissing a complaint against such a "room rate" it was said that in any revision of rate schedules, especially when such schedules effected a consolidation of two or more classes of service into one schedule, there may be some customers who suffer prejudice thereby, but that if this prejudice be not unreasonable and the greatest good is afforded to the greatest number, such prejudice should not stand in the way of an otherwise desirable form of rate schedule. In the particular instance before the commission the testimony indicated that only 24 customers would have higher bills, while upward of 4,000 would be benefited by composite reduction in charges approximating $20,000, and that costs were reasonably allocated. All customers taking lighting service alone would have decreased bills.

News About Men of the Industry

J. B. Miller Thirty Years With Edison Company

John B. Miller on Feb. 1 celebrated the completion of 30 years' service with the Southern California Edison Company. In 1898 Mr. Miller became associated with the Edison Electric Company, predecessor of the present organization, in the capacity of treasurer, which position he held until 1901, when he was elected president, the position

J. B. MILLER

which he has held continuously for the intervening 27 years. In 1896 Mr. Miller, then 27 years of age, visited Southern California for the first time and within two years had launched upon his life's work. His first task was to amalgamate several small power companies and to organize larger and more efficient operating units, the present Southern California Edison Company, operating in ten counties of southern and central California, being the result.

In addition to being the directing officer of the Edison company Mr. Miller is president of the Landowners Company, president San Joaquin & Eastern Railroad Company, chairman of board Electrical Products Corporation, director Los Angeles First National Trust & Savings Bank, Pacific Mutual Life Insurance Company, Federal Telegraph Company of Delaware, Pacific Finance Corporation, Pacific Indemnity Company, Bellows Claude Neon Company, Detroit; Claude Neon Federal Company, Chicago; Claude Neon Lights, Inc., New York, and Diamond Electrical Manufacturing Company.

L. P. Sweatt Vice-President of Mississippi Company

L. P. Sweatt, Jr., general manager of the Mississippi Power Company, Gulfport, Miss., since its organization, has been elected vice-president of that utility. At an early age Mr. Sweatt became interested in the public utility industry. For several years he was employed in the railroad branch of the business before entering the Alabama Polytechnic Institute at Auburn and he financed his technical education at that institution by acting as chief engineer of the power plant furnishing electricity to the college and city of Auburn.

Mr. Sweatt started with the Alabama Power Company in the capacity of a helper in substation maintenance, and step by step he has advanced, serving successively as foreman of substation construction, member of the commercial department, superintendent of the western division, manager of that division, manager of the eastern division and manager of the southern division. It was in 1925 that Mr. Sweatt assumed the duties of general manager of the Mississippi Power Company, which he will continue to carry on in addition to those pertaining to his new position.

E. C. Brandt, who has been connected with the Westinghouse Electric & Manufacturing Company since 1905, has been appointed assistant works manager of the East Pittsburgh works.

E. W. Dillard Receives New Appointment

Edward W. Dillard has been appointed electrical engineer of the New England Power Company system, following eight years' service in the electrical engineering department of that organization. Mr. Dillard is a native of Alabama, was educated at the Alabama Polytechnic Institute and at one time was employed by the General Electric Company and then by the Alabama Power Company. He joined the staff of the New England Power Company at Worcester in 1916 as chief of tests, being in charge of all meter, relay, oil circuit breaker and telephone inspection and maintenance for two years. In 1919

E. W. DILLARD

he entered the department which he now heads, and for some time specialized in problems of relay operation and maintenance, acquiring a high reputation as a specialist in this field in the New England territory.

N. E. Funk Chief Engineer of Philadelphia Electric

Nevin E. Funk, who has been assistant chief engineer of the Philadelphia Electric Company for the past year, has been appointed chief engineer of that company to succeed the late William C. L. Eglin. Mr. Funk affiliated himself with the Philadelphia utility nineteen years ago and during this period of service he has been closely identified

N. E. FUNK

with the planning and operations of the three large generating stations as well as with the huge hydro-electric plant now being constructed at Conowingo. A graduate of the Bloomsburg (Pa.) State Normal School and of Lehigh University, Mr. Funk entered upon his engineering career as an apprentice with the Westinghouse Electric & Manufacturing Company. Subsequently he was identified with the New York Central Railroad and later with the teaching staff of the Georgia School of Technology.

He started with the Philadelphia Electric Company as assistant foreman in the station electrical construction department, occupying successively the positions of assistant superintendent, combustion engineer, superintendent of Schuylkill station, assistant operating engineer, operating engineer and assistant chief engineer.

Mr. Funk is a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Society for Testing Materials and other technical organizations, and has been active in the work of the prime movers committee of the National Electric Light Association.

Austin D. Barney has been elected general counsel of the Hartford Electric Light Company, Hartford, Conn., to succeed the late Judge William F. Heeney. Mr. Barney has been with the company as an attorney for several years and was assistant to Judge Heeney.

Financial and Statistical News

Stocks React Drastically Money Rates Firm Bond Prices Unaffected

THE drastic downward readjustment through which the securities markets have passed within the last week brought several of the utilities down sharply, although as a group they were affected less than most of the other main groups. The average of a representative group of fifteen power and light common stocks reacted from 130 to 127, the former figure being the high point for these issues for all time. Brooklyn Edison lost eight points, to 226; Edison Electric Illuminating of Boston dropped eleven points, to 254; Pacific Gas & Electric is down twelve points, to 182; Montana Power reacted to 147 from a recent high of 165.

More attention, evidently, is being paid to money rates, in response to the action of the Federal Reserve banks. Rate increases were introduced by three of the reserve banks, Chicago, New York and Richmond. In the middle of February a 4 per cent rate was in effect in ten of the twelve reserve districts. Increases were made, apparently, in anticipation rather than as a result of increased demand for funds.

While it has had a radical effect on the stock markets, this general firming of money rates has had no apparent effect on the prices of higher grade bonds. The better class of power and light bonds are stated to be in just as keen demand as before these rate adjustments, although selling has been heavy in classes of bonds other than the utilities.

PHILADELPHIA ELECTRIC ELECTS NEW DIRECTORS.—At a recent meeting of the board of directors of the Philadelphia Electric Company Arthur W. Thompson, president of the United Gas Improvement Company; Samuel T. Bodine, chairman of the board of the United Gas Improvement Company, and William H. Taylor, formerly vice-president of the United Gas Improvement Company and now president of the Philadelphia Electric Company, were elected members of the board. These three new members are replacing Walter H. Johnson and A. V. R. Coe, resigned, and W. C. L. Eglin, deceased.

American Superpower to Recapitalize

Revision of the capital structure of the American Superpower Corporation has been announced by President L. K. Thorne. The proposed plan calls for the immediate retirement of the outstanding participating preferred stock, the proceeds for which will be raised through the sale of additional class "A" common stock at $33 per share. This stock will be offered to all common stock holders, class A and class B, of record Feb. 20, 1928, on the basis of one share for each four shares held. In addition to the common stock the company has offered for sale 90,000 additional shares of first preferred stock, the proceeds of which will be used to finance certain large investments recently made by the corporation.

Stockholders also will be asked to approve the creation of a new class of preference stock (junior to the first preferred stock) cumulative as to dividends at the rate of $6 per share annually, and callable at $107.50 per share. If this proposal is approved the directors will distribute the stock to common stock holders on the basis of one share of new preference stock for each five shares of class A or class B common stock held. The additional common stock subscribed for at $33 per share on or before March 6 will receive its pro rata share of new preference stock.

December Operations Greater Than Ever Before

Revenue of $166,200,000 Exceeds Previous Peak—Energy Output, 6,782,000,000 Kw.-Hr., Also Breaks Records—Water Power Furnishes Nearly 40 Per Cent

NOTWITHSTANDING the slowing down of business activity in general toward the end of 1926, December operations in the electric light and power industry were greater than ever before, whether measured by energy output or by revenue. The energy output, 6,782,004,000 kw.-hr., exceeded that of November by 4.2 per cent; it was 6.3 per cent greater than the output of December, 1926. Both of these figures, while in harmony with the strong upward trend that has characterized the industry since its inception, are slightly below the usual seasonal and annual increase, respectively. The average daily output, 219,000,000 kw.-hr., happens to coincide exactly with the normal, previously computed on the basis of the preceding five-year returns.

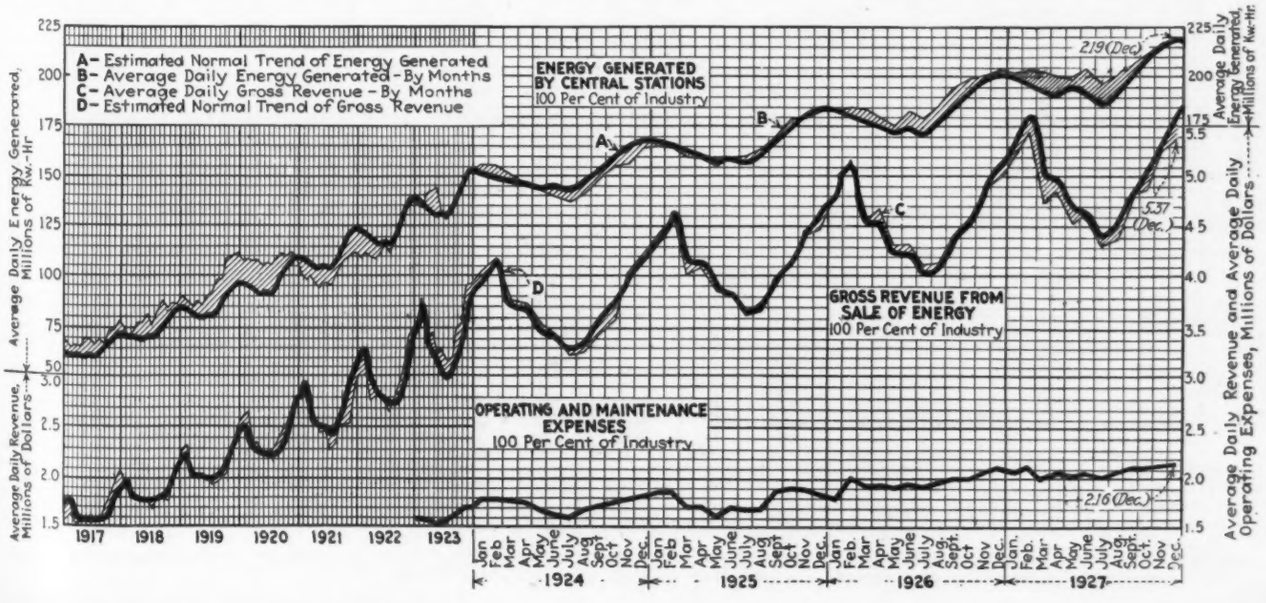

A- Estimated Normal Trend of Energy Generated
B- Average Daily Energy Generated - By Months
C- Average Daily Gross Revenue - By Months
D- Estimated Normal Trend of Gross Revenue
ENERGY GENERATED BY CENTRAL STATIONS
100 Per Cent of Industry
GROSS REVENUE FROM SALE OF ENERGY
100 Per Cent of Industry
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
219 (Dec.)
5.37 (Dec.)
2.16 (Dec.)
Average Daily Energy Generated, Millions of Kw.-Hr.
Average Daily Revenue, Millions of Dollars
Average Daily Revenue and Average Daily Operating Expenses, Millions of Dollars
1917 1918 1919 1920 1921 1922 1923
1924 1925 1926 1927

TABLE I—GENERATION AND DISTRIBUTION OF CENTRAL-STATION ENERGY IN THE UNITED STATES
(100 Per Cent of the Industry)

Month	Kw.-Hr. Generated Monthly *			Estimated Distribution of Energy Generated										Energy Purchased by Public Utilities for Resale, Kw.-Hr.	
				Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting, Kw.-Hr.		Energy Consumed for Power, Kw.-Hr.		Energy Sold to Electric Railways, Kw.-Hr.		Energy Used in Intracompany Business, Including Line Losses, Kw.-Hr.			
	1927 Thousands	1926 Thousands	Per Cent Inc.	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands
Sept...	6,268,814	5,825,852	+7.6	5,158,814	4,701,852	1,274,000	1,188,000	3,373,814	3,009,852	511,000	504,000	1,110,000	1,124,000	1,299,000	1,225,000
Oct...	6,577,566	6,174,959	+6.5	5,413,566	4,982,959	1,372,000	1,262,000	3,485,566	3,172,959	556,000	548,000	1,164,000	1,192,000	1,290,000	1,240,000
Nov....	6,507,024	6,063,784	+7.3	5,355,024	4,989,784	1,400,000	1,310,000	3,396,024	3,128,784	559,000	551,000	1,152,000	1,074,000	1,269,000	1,200,000
Dec...	6,782,004	6,375,500	+6.3	5,592,004	5,247,500	1,500,000	1,400,000	3,462,004	3,226,500	630,000	621,000	1,190,000	1,128,000	1,286,000	1,175,000

*Data on "energy generated" are those collected and published by the United States Geological Survey for all public utilities minus such data as are collected on energy generated by electric railway companies, reclamation service and manufacturing plants. The data are, therefore, for the electric light and power industry only

The revenue, $166,200,000, exceeded the previous maximum of $162,000,000 attained in January, 1927. It was equivalent to a daily average of $5,370,000. This is but little less than the maximum ever recorded, which happened last February, when payments for a long month of heavy energy consumption were concentrated into a short one. The month's revenue exceeded that of December, 1926, by 7.3 per cent, and in accordance with the usual seasonal swing was 5.2 per cent higher than in the preceding month, but it fell about 5 per cent short of the estimated normal, based on former years.

This December departure downward from the computed normal is not new; it occurred both in 1925 and in 1926, whereas in some other years the variation was upward.

Operating expenses, which on the basis of returns received are estimated at $67,100,000 for the industry as a whole, were but 5.8 per cent higher than the year before, so that despite the moderate increase in gross revenue the net rose 8.4 per cent. In certain instances reports of operating expenses showed an actual reduction, suggesting a definite policy of retrenchment, but in general there is no evidence of drastic economies.

Of the total energy output 2,689,900,000 kw.-hr., or almost 40 per cent, came from water power. The increase of this item was 13.1 per cent, whereas the energy generated from fuel was only 2.3 per cent greater than in December, 1926. Thus, more than half the increment was borne by water power. Production of energy from fuel shows continued improvement in efficiency. The increased output was achieved with 2.6 per cent less coal and 21.1 per cent less fuel oil; the reduction far outweighs the 31.6 per cent increase in the consumption of natural gas. Oil consumption, while greater than in recent months, continues extremely low compared with previous years.

Regional analysis of the changes in energy output, compared with December, 1926, indicates an increase in New England of 1 per cent, in the Atlantic States of 6 per cent, the North Central 6, the South Central 10, and in the Western States of 4 per cent. The most rapid growth continues to be in the Southwest. Similarly the revenue rose, in New England 5.9 per cent, in the Atlantic States 6.0 per cent, North Central 9.7, South Central 9.7 and in the Western States 4.7 per cent.

The increasing use of energy for industrial purposes is apparently reflected in the gradual flattening of the output curve. During the past two years the seasonal fluctuations have been smaller than before. The winter peaks have checked quite closely with the values estimated in advance based on previous growth, but the summer sag has been very much smoothed out.

TABLE II—OPERATING RATIO OF CENTRAL-STATION COMPANIES

Month	Operating Ratio					
	Steam Plants		Hydro Plants		Combined Hydro and Steam Plants	
	1927	1926	1927	1926	1927	1926
Sept..	48.8	49.7	33.4	37.5	42.1	43.3
Oct..	46.9	48.3	31.8	32.8	42.6	43.0
Nov..	44.7	45.8	31.0	29.6	41.0	42.0
Dec..	44.0	44.6	31.1	31.4	38.4	40.2

PACIFIC GAS & ELECTRIC TO ISSUE BONDS.—Permission has been granted by the Railroad Commission of California to the Pacific Gas & Electric

TABLE III—CENTRAL-STATION FINANCIAL OPERATIONS FOR FOUR MONTHS IN THE UNITED STATES
(100 Per Cent of the Industry)

Month	Total Gross Revenue from Sale of Energy†			Estimated Distribution of Gross Revenue								Total Operating and Maintenance Expenses‡	
				Lighting Customers		Power Customers		Electric Railways		Other Public Utilities			
	1927 Thousands	1926 Thousands	Per Cent Inc.	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands	1927 Thousands	1926 Thousands
Sept.....	$144,400	$132,600	+8.9	$84,200	$80,500	$44,400	$38,000	$4,600	$4,500	$11,200	$9,600	$63,600	$60,300
Oct.....	150,800	141,800	+6.4	88,700	84,100	45,900	42,000	4,600	4,600	11,600	11,100	64,450	62,950
Nov.....	158 000	148,300	+6.5	94,300	89,100	47,200	43,200	5,000	4,900	11,500	11,100	64,300	62,450
Dec.....	166,200	154,800	+7.4	100,600	94,700	48,700	43,900	5,100	5,000	11,800	11,200	67,100	63,400

†Aggregate gross revenue from actual consumers, and sales to other public utilities for resale, involving a certain amount of duplication.
‡Do not include interest, taxes, depreciation or sinking fund.

TABLE IV—OPERATIONS OF CENTRAL-STATION HYDRO AND FUEL PLANTS IN THE UNITED STATES*
(100 Per Cent of the Industry)

Month	Energy Generated						Fuel Consumption								
	Hydro-Plants			Fuel Power Plants			Coal			Oil			Gas		
	1927 Thousands of Kw.-Hr.	1926 Thousands of Kw.-Hr.	Per Cent Increase	1927 Thousands of Kw.-Hr.	1926 Thousands of Kw.-Hr.	Per Cent Increase	1927 Short Tons	1926 Short Tons	Per Cent Increase	1927 Barrels	1926 Barrels	Per Cent Increase	1927 Thousands of Cubic Feet	1926 Thousands of Cubic Feet	Per Cent Increase
Sept.....	2,168,531	2,033,312	+ 6.7	4,100,283	3,792,540	+8.1	3,242,546	3,114,535	+4.1	478,816	883,913	—45.9	6,474,756	4,816,955	+34.4
Oct.....	2,350,030	2,122,336	+10.7	4,227,536	4,052,623	+4.3	3,332,729	3,317,113	+0.5	483,554	879,929	—45.1	6,424,859	4,872,740	+31.8
Nov.....	2,457 463	2,193,093	+12.0	4,049,561	3,870,691	+4.6	3,231,891	3,193,212	+1.2	483,455	926,916	—47.6	5,630,302	3,975,408	+41.6
Dec.....	2,689,900	2,377,175	+13.1	4,092,104	3,998,325	+2.3	3,315,963	3,406,140	—2.6	607,393	769,518	—21.1	4,851,762	3,685,611	+31.6

*As collected by United States Geological Survey. The data are for the electric light and power industry only.

Company to issue and sell on or before June 1, 1928, at not less than 96 per cent of face value, plus accrued interest, $20,000,000 of first and refunding mortgage gold bonds, series "E," bearing interest at the rate of 4½ per cent per annum, and to use the proceeds to pay in part for the properties of Coast Valleys Gas & Electric Company and Western States Gas & Electric Company, and to refund outstanding bonds or notes of those companies.

Electric Bond and Share to Change Set-up

At recent meetings of the boards of directors of the Electric Bond & Share Company and the Electric Bond & Share Securities Corporation it was determined to recommend to the stockholders of the two companies that the authorized shares of the capital stock of each of the corporations be increased. It is proposed to authorize an additional 1,000,000 shares of common and an additional 1,000,000 shares of preferred stock of Electric Bond & Share Company and to increase the authorized shares of common stock of the Securities Corporation from 1,802,870 to 4,000,000. Meetings have been called for March 5, 1928.

Public Service of Northern Illinois Increases Net 15 Per Cent

ALTHOUGH Public Service Company of Northern Illinois did not show so great a growth in 1927 over 1926 as in 1926 over 1925, the progress made was almost as great. Gross revenue increased 11.8 per cent, as against 12.9 per cent the previous year. Operating costs were unusually well regulated, showing an increase of only 9.7 per cent, allowing for a 15.2 per cent expansion in net operating revenues during the period.

After all deductions gross income showed a growth of 13.9 per cent, against 14.5 per cent a year ago. The amount available for dividends in 1927 was $5,186,013, an increase of 5.9 per cent. Of this amount, $3,443,914 was distributed as dividends and $1,742,098 was added to surplus. It will be noted that rate reductions were made from time to time, and such reductions lowered the increase in operating revenues and the amount available for dividends on preferred and common stock for 1927 by about $685,000.

Total sales of electricity for the year, in kilowatt-hours, were 739,718,878 against 597,061,783 for 1926. Exclusive of sales to other electric companies, electric sales totaled 551,556,023, an increase of 13 per cent over 1926. The gain in total connected lighting load, over 1926, was 19 per cent. The total contracted power business for the year amounted to 55,250 hp., a gain of 21 per cent over 1926.

The financial set-up of the company was altered during the year by the issue of $10,000,000 in principal amount of 5 per cent debentures due August, 1932, and $750,000 of first lien and refunding 5 per cent mortgage bonds, series C, of 1966. Returns were used to purchase property and equipment, to acquire at par $4,245,000 of the first mortgage bonds of the Waukegan Generating Company and to refund certain of the company's own bonds. Furthermore, 3,500 shares of no-par common stock were sold to employees at an advantageous price.

Interest charges for the year were earned 2.4 times.

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Monday Feb. 20	Low 1927	High 1927
ABITIBI PWR. & PAPER, com., new — no par	73	72*	81*
Ala. Pwr., $7 com. pf.—no par	114½	107	115
Allis-Chalmers Mfg., 6% com.	117	115½*	125*
Aluminum Co. of Amer., com.	k136	120*	136*
Aluminum Co. of Amer., 6% pf.	106½	105½*	107½*
Amer. & Foreign Pwr., 7% pf.—no par	107	105½*	108½*
Amer. & Foreign Pwr., com.—no par	23½	22½*	27½*
Amer. Bosch Magneto, com.—no par	17½	15½*	22½*
Amer. Brown Boveri Elec.†	16	14½*	18*
Amer. Brown Boveri Elec., pf. $7	56½	55*	63*
Amer. Gas & Elec., 6% pf.—no par	107	106½*	109*
Amer. Gas & Elec., com. †—no par	121	117*	126½*
Amer. Lt. & Trac., 6% pf.	115	115*	115½*
Amer. Lt. & Trac., new com.	182	170*	191*
Amer. Pwr. & Lt., 6% pf.	105½	104½*	109½*
Amer. Pwr. & Lt., com. †—no par	65½	62½*	69½*
Amer. Pub. Serv., 7% pf.	k 99½	99*	100*
Amer. Pub. Serv., com. †	k 70	65	75
Amer. Pub. Utilities, 7% ptc. pf.	90	73	90
Amer. Pub. Utilities, 7% pr. pf.	97½	88	97
Amer. Pub. Utilities, com.	k 60	58	70
Amer. States Sec., A	5	2½	5½
Amer. States Sec., B	5½	2½	5½
Amer. Superpwr., 6% ptc pf.—25	30	28½*	30*
Amer. Superpwr., 6% 1st pf.	l 103	....	....
Amer. Sup pwr., Class A†—no par, ex. rts.	40½	37*	41½*
Amer. Sup'pwr., Class B†—no par, ex. rts.	40½	37½*	43*
Amer. Wtr. Wks. & Elec., 6% pf.	105	101½*	105*
Amer. W. W. & E., com. new—no par	56½	54½*	61*
Anaconda Copper cap. $3	55½	53½*	59½*
Appalachian Electric Pwr., 7% pf.	109	100	109
Arkansas Pwr., & Lt. 7% pf.	107½	101	108
Assoc. Gas & Elec., $3.50—50	54	....	....
Assoc. Gas & Elec., pf.—$6—no par	95	85	98
Assoc. G. & E., Class A, 10—no par	47½	47½*	51½*
BABCOCK & WILCOX, 7% com.	120	120*	124½*
Binghamton L., H. & P., $6 pf.	105½	93	103½
Birmingham Elec., pf.—$7—no par	110	105	111½
Blackstone Valley G. & E., 6% pf.	k107	103	110
Blackstone Valley Gas & Elec., 10% com.—50	k128	132*	135½*
Blaw-Knox, com.†	c105	91*	105*
Brazilian Trac., Lt. & Pwr., $7 com.	f201	....	....
Brazilian Trac., Lt. & Pwr., com., new	f 51½	....	....
Broad River Pwr., 7% pf.	105½	97	105½
Brooklyn Edison, 8% com.	226½	206½*	235½*
Buffalo, Niagara & East. Pwr., $1.60 pf.—25	l 26½	....	....
Buffalo, Niagara & East. Pwr. com., $1.20—no par	l 35½	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	k 99	96	104½
California Ry. & Pwr., 7% pf.	k135	125	150
Carolina Pwr. & Lt., pf.—$7—no par	l110½	109*	1l0½*
Central & S. W. Util., $7 pf.—no par	a102½	99½*	105½*
Central & S. W. Util., pr. ln. $7 pf.—no par	a105	104½*	108*
Central Ark. Ry. & Lt., 7% pf.	104	100	107*
Central Ill. Pub. Serv., $6 pf.	a 99	97½*	99*
Central Ind. Pwr., 7% pf.	a 97	95*	99½*
Central Maine Power, 6% pf.	95	....	....
Central Maine Power, 7%	107	102	110
Central Pwr. & Lt., 7% pf.	98	100½	105
Central States Elec., 7% pf.	105	104½*	107½*
Century Elec., 6% com.	b145	140*	145*
Chicago Fuse Mfg., com.—$2.50 no par	m 30	30*	33½*
Cincinnati Gas & Elec., 5% com.	g 97½	97½*	100*
Cities Service, $6 pf.—no par	i 95½	87*	94½*
Cities Service, pf. B—no par	i 9	8*	8½*
Cities Service, pf. BB—no par	i 90	80½*	86*
Cities Service, com.—20	b55½	40½*	58½*
Cities Service, Bks. Shrs.—10	i 27½	22½*	27 *
Cities Service Pwr. & Lt., 7% pf.	106½	105½*	106½*
Cities Service Pwr. & Lt., 6% pf.	96½	95½*	96½*
Cleveland Elec. Illg., 6% pf.	114	108	114
Cleveland Elec. Illg., 10% com.	360	285	370
Columbia Gas & Elec., 6% pf.	k108	107½*	110½*
Columbia G. & E. com. $5—no par	91½	89½*	97½*
Columbus Elec. & Pwr., $2 com.—no par	k 70	66*	71*
Columbus Elec. & Pwr., 7% pf.	113	....	....
Columbus Ry., Pwr. & Lt., 7% pf.	107½	98½	108½
Columbus Ry., Pwr. & Lt., 7 %pf. B	105½	96	106
Columbus Ry., P. & Lt. com.—no par	105	75	110
Commonwealth Edison, 8% com.	a176	165*	189*
Commonwealth Pwr., 6% pf.	k103½	102½*	104½*
Commonw'th Pwr., $2, com.—no par	65	62½*	69*
Conn. Lt. & Pwr., 8% pf.	119	119	123
Conn. Lt. & Pwr., 7% pf.	116	112	119
Cons. Gas of N. Y., pf.	101½	101½*	102½*
Cons. Gas of N. Y., com. $5—no par.	130½	119½*	139½*
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	e112½	110½*	113*
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	e110½	110½*	113*
Cons. Gas, Elec. Lt. & Pwr. of Balti., 7% pf.	e110½	110½*	115*
Cons. Gas, Elec. Lt. & Pwr. of Balti., 8% pf.	e125½	125½*	128½*
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $3.00—no par.	e 71½	67½*	72½*
Consolidated Pwr. & Lt., 7% pf.	105	100	106
Consumers Pwr., 6% pf.	104½	100	106½
Consumers Pwr., 6.6% pf.	106½	103	107½
Continental Gas & Elec., 7% pr. pf.	107	100	107½
Contl. G. & E. com. $4.40—no par.	k240	210	265
Crocker Wheeler, com.†	30	23	38
Crocker Wheeler, 7% pf.	90	78	88
DALLAS PWR. & LT., 7% pf.	110½	107	111½
Dayton Pwr. & Lt., 6% pf.	108½	101	109½
Detroit Edison, 8% com.	176	166½*	194½*
Dubilier Condenser, com.—no par.	3½	2½*	3½*
Duke Pwr., cap.	135	135½	145*
Duquesne Lt., 7% pf.	116½	115½*	116½*
EASTERN NEW YORK UTIL., $7 pf.	k110½	102	112½
Eastern New York Util. com.	k 65	70	75
Eastern States Pwr. $7, com.	k 12	11½*	15½*
Eastern States Pwr., pf.	k 97	90	99
East. Tex. Elec., 7% pf.	108	106	109
Edison Elec. of Boston, $12 com.	d254	254*	268*
El Paso Elec. 7% pf.	113	105	112½
Elec. Bond & Share, 6% pf.	l110	109½*	111½*
Elec. Bd. & Sh. Sec., com. $1—no par	l 86½	76*	94½*
Electric Household Util.†	a 14½	13½*	15½*
Elec. Investors, 6% pf.—no par.	102	92	101
Elec. Investors, com.†—no par.	41½	40½*	45½*
Elec. Pwr. & Lt., ctfs. pf.	108½	106½*	108½*
Elec. Pwr. & Lt., ctfs., 40% pd.	k123½	120½*	123*
Elec. Pwr. & Lt., ctfs., com.—no par	33	28½*	34½*
Elec. Refrig. cap.†	14	11½*	15½*
Elec. Ry. Securities, com.—no par	6½	....	....
Elec. St. Battery com. $5.25—no par	69½	69½*	75½*
Elmira Wtr., Lt. & R.R., 7% pf.	k105	99	105½
Empire Pwr., ptc.†	30	27½*	35½*
Engr. Pub. Serv. $7. pf.—no par.	k109	107*	109½*
Engr. Pub. Serv., com.—no par.	34	33*	35½*
Eureka Vacuum Cleaner, com. $4—no par.	70½	69½*	79*
FAIRBANKS MORSE, 7% pf.	105½	104*	1C6½*
F.-M., com.—$3—no par.	k 36	32½*	40½*
Federal Lt. & Trac., com $1.40	49½	42*	55*
Federal Lt. & Trac., $6 pf.—no par.	lu2	98*	105*
Florida Pwr. & Lt., 7% pf.	107	104½*	107½*
Ft. Worth Pwr. & Lt., 7% pf.	l113½	113*	114½*
GALVESTON-HOUSTON ELEC. 6% pf.	77	68	85
Galveston-Houston Elec., com.	32	26	32
General Cable, Cl. A	61½	56*	62½*
Gen. Elec. $3 com.—no par.	127½	125½*	138½*
Gen. Elec., special—6%	k 11½	11½*	11½*
Gen. Gas & Elec. (Del.) com A $1.50—no par	36½	35½*	39½*
Gen. G. & E. (Del.) pf. A $8—no par	122½	122½*	126½*
Gen. G. & E. (Del.) pf. A $7—no par.	k112½	108½*	112½*
Gen. G. & E. (Del.) pf. B $7	k107	105½*	107*
Gen. Pub. Serv., $7 cum. pf., no par.	k120	115*	120*
Gen. Pub. Serv., com., no par	19	16½*	20½*
Ga. Lt., Pwr. & Rys., com.	k 58	50	70
Ga. Ry. & Pwr., 6% pf.	k125	119	125
Ga. Ry. & Pwr., 7% pf.	k113½	106	115
Gt. Western Pwr., 7% pf.	k105	....	....
IDAHO PWR., 7% pf.	109	103	110
Ill. No. Utilities, 6% pf.	a 99½	98½*	99½*
Ill. Pwr. & Lt., 7% pf.	104½	99	104½
Ingersoll Rand com.	90½	90½*	94*
Int. Combus. Engr., com. $2—no par	47½	45½	55½*
Int. Combustion Engr., 7% pf.	k104	104*	105½*
Int. Util., Class A—$3.50—no par.	45	45*	51½*
Int. Utilities, Class B—no par.	7½	6½*	•10½*
Interstate Pwr., pf.—$7—no par.	100½	93	100
Interstate Pub. Serv., 7% pf.	104	98	104
Iowa Ry. & Lt., 7% pf.	k100	97	100
JERSEY CENTRAL PWR. & LT. CO., 7% pf.	107½	97½	108
Johns-Manville, com.†—no par.	116	114*	125
Johns-Manville, 7% pf.	119½	119½*	120*

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, Feb. 18. lBid price Tuesday, Feb. 21. mLatest quotations available. †Dividend rate variable. *1928

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Monday Feb. 20	Low 1927	High 1927
KANSAS CITY PWR. & LT. pf. $7	111⅛	111⅛*	111⅛*
Kansas Gas & Elec., 7% pf.	*l*109⅛	107*	109*
Kentucky Hydro-Elec., 7% pf.	*a*104	102*	104*
Kentucky Sec., 6% pf.	92	83	90
Kentucky Sec., 5% com.	140	100	135
Kentucky Utilities, 6% pf.	*k*101	95	101⅛
LACLEDE GAS LT., 10% com.	*k*230	200*	260*
Lehigh Pwr. Sec., com.—no par.	25	19⅛*	27⅛*
Long Island Ltg., 7% pf.	112⅛	110⅛*	112⅛*
Long Island Ltg., com.†—no par	*k*170	139	180
Los Angeles Gas & Elec., 6% pf.	108	98	105
Louisville Gas & Elec., cl. A. $1.75	29⅛	28*	29⅛*
MAN. ELEC. SUPPLY, cap. $5—no par	51⅛	50*	54⅛*
Manilla Elec., com.†—no par	*k* 45	45⅛*	50*
Maytag Mfg.,com.50—no par,	31	30⅛*	34⅛*
Memphis P. & L., pf.—$7—no par	*k*109⅛	107	111
Metropolitan Ed., pf.—$6—no par	106⅛	93	106
Metropolitan Ed., pf.—$7—no par	109	104	110
Metropolitan Ed., com. $5—no par	*k*140	60	72
Middle West Utilities, 7% pf.	*a*128	116⅛*	124⅛*
Middle West Util., 7% pr. lien	*a*128	125⅛*	129⅛*
Middle West Util., com. $6—no par	*a*130	123⅛*	135*
Midland Utilities, pr. ln. 7% pf.	*a*106⅛	104*	106⅛*
Midland Utilities, 7% pf. A	*a*104	103*	104⅛*
Milwaukee Elec. Ry. & Lt., 7% pf.	*k*103	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	*k* 99	98	101⅛
Minn. Pwr. & Lt., 7% pf.	*l*109	107*	109*
Miss. River Pwr., 6% pf.	108	94	108
Miss. River Pwr., 3% com.	*m* 62	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par	*k*107	100	109
Mohawk Hudson Pwr., 2d pf.—$7—no par	*k*104	106⅛*	110*
Mohawk Hudson Pwr., com.—no par	30	29⅛*	31⅛*
Montana Pwr., 5% com.	148⅛	102⅛*	165⅛*
Montreal Pwr., 7⅛% com.	*f* 90⅛	....	....
Mountain States Pwr., 7% pf.	*k*103	97	103
Mountain States Pwr., com.†	16⅛	....	....
NASSAU & SUFFOLK LTG., 7% pf.	109	98	110
National Carbon, 8% pf.	*a*138⅛	138*	139*
National Elec. Pwr., A†	*a* 30⅛	27⅛*	32⅛*
National Lt., Ht. & Pwr., com.	*k* 24	20	30
National, Light, Ht. & Pwr., 5% pf.	*k* 72	70	80
National Pwr. & Lt., pf.—$7—no par	110	108⅛*	111*
National Pwr. & Lt., com.†—no par.	25⅛	21⅛*	27⅛*
National Pub. Serv., 7% pf.	102⅛	93	102
National Pub. Serv., 7% ptc., pf.	114	108	115
National Pub. Serv., A com. $1.60—no par	25⅛	22*	27⅛*
National Pub. Serv., B com.—no par	27⅛	24⅛*	30*
Nebraska Pwr., 7% pf.	*l*110	110*	111⅛*
Nevada-Calif. Elec., com.	*k* 35	22	37
New Brunswick Pwr., 4% pf.	*k* 60	69	70
New Eng. Pub. Serv., pr. ln. pf. $7	*k*109	98⅛	104
New Eng. Pub. Serv., pf. $7	*k*108	95	100
New Orleans Pub. Serv.—7% pf.	108⅛	103	110
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	100	91	100
N. Y. Central Elec., 7% pf.	*k*103	101	104
New York Power & Light 8% pf.	114	....	....
New York Power & Light, 7% pf.	114⅛	....	....
Newport News & Hampton Ry., Gas & Elec., 5% com.	*k*109	110	115
Newport News & Hampton Ry., Gas & Elec., 7% pf.	*k*109	110	115
Niagara Falls Pwr., 7% pf.—25	*k* 28⅛	28*	28⅛*
No. Amer., 6% pf.—50	54⅛	53⅛*	54⅛*
No. Amer., com., no par	60⅛	58⅛*	62⅛*
No. Amer. Edison, $6 pf.—no par	103⅛	102⅛*	105⅛*
No. Caro. Pub. Serv., pf.—$7—no par	109	93	105
Northeastern Pwr., com.	20⅛	19⅛*	23 *
No. N. Y. Utilities, 7% pf.	107	103	109
No. Ohio Pwr., com.—no par.	22⅛	18*	24⅛*
No. Ont. Lt. & Pwr., 6% pf.	*k* 98	98*	98⅛*
No. Ont. Lt. & Pwr., 4% com.	*k* 72	73	78
No. States Pwr. (Del.), 7% pf.	*k*108⅛	108⅛*	109⅛*
No. States Pwr. (Del.), 8% com.	131⅛	123*	136⅛*
No. Texas Elec., 6% pf.	58	45	70
No. Texas Elec., com.	18	5	36
OHIO BRASS, com. B $4—no par.	97	89*	98⅛*
Ohio Brass, 6% pf.	*k*107	100	111
Ohio Pwr., 6% pf.	*k*106	96	106
Ohio Pub. Serv., $6 pf.	*k*102⅛	95	102
Ohio Pub. Serv., 7% pf.	110⅛	103	111
Ohio River Edison, 7% pf.	109⅛	103	109⅛
Oklahoma Gas & Elec., 7% pf.	112	....	....
PACIFIC Gas & ELEC., 6% pf.	*k* 27	26⅛*	27⅛*
Pacific Gas & Elec., 8% new com.	45⅛	45⅛*	49⅛*
Pacific Pwr. & Lt., 7% pf.	*l*108⅛	106*	108⅛*
Penn Cent. Lt. & Pwr., $5 pf.—no par	*c* 79⅛	77⅛*	79⅛*
Penn-Ohio Edison, 6% pf. no par	93⅛	93⅛*	96*
Penn-Ohio Edison, 7% pf.	107	107*	109*
Penn-Ohio Pwr. & Lt., 7% pf.	109⅛	99	110
Penn Pwr. & Lt.—$7—no par	*l*110⅛	109⅛*	110⅛*
Penn Wtr. & Pwr., $2.50 com., new	*e* 70	68*	72⅛*
Phila. Co., 5% pf.—50	*k* 45⅛	46⅛*	48⅛*
Phila. Co., 6% pf.—50	52⅛	52*	53*
Phila. Co., com.—50	*k*150	149⅛*	163*
Phila. Elec., 8% com.—25	*c* 57⅛	55⅛*	59*
Portland Elec. Pwr., 7% pf.	103⅛	97⅛	102⅛
Portland Elec. Pwr., 6% pf.	94	78	84
Portland Elec. Pwr., 6% 2d pf.	85	55	70
Portland Elec. Pwr., com.	48	42⅛*	50⅛*
Potomac Elec. Power, pf.	*k*111	110	111⅛
Pwr. Sec., pf.—no par	*k* 58	28	60
Pwr. Sec., com.—no par	*k* 12	5	15
Public Serv. of Colorado, 7% pf.,	*l*108	99*	103*
Pub. Serv. of N. J., 6% pf.	*k*105⅛	103⅛*	106⅛*
Pub. Serv. of N. J., 7% pf.	119⅛	118*	120⅛*
Pub. Serv. of N. J., $2 com.—no par	42⅛	41⅛*	45*
Pub. Serv. of No. Ill., 6% pf.	*a*110	110*	110*
Pub. Serv. of No. Ill., 7% pf.	*a*119	119*	121*
P. S. of No. Ill., com. $8—no par	*a*168⅛	159⅛*	180*
Pub. Serv. of No. Ill., $8 com.	*a*169	159⅛*	180*
Pub. Serv. of Okla., 7% pr. ln.	*k*105	90	103
Pub. Serv. Elec. & Gas, 6% pf.	109⅛	109*	110⅛*
Puget Sound Pwr. & Lt., 7% pf.	110⅛	109*	113*
Puget Sound Pwr. & Lt., $6 pf.—no par	98⅛	92*	98⅛*
Puget Sound Pwr. & Lt., com.	46⅛	34⅛*	50*
RADIO COPR. OF AMER., $3.50 pf.—50	*k* 92⅛	87⅛*	57⅛*
Radio Corp. of Amer., com.—no par.	88⅛	85⅛*	104⅛*
Rhode Island Public Service, pf. $2—no par	*k* 31⅛	30⅛*	31⅛*
Rochester Gas & Elec. 6% pf. D.	*k*105⅛	101	103⅛
Rochester Gas & Elec., 7% pf. B.	107	105	107
Rochester Gas & Elec., 7% pf. C.	105	101⅛	103⅛
SAN JOAQUIN Lt. & Pwr., 7% pr. pf.	*k*114	105	112⅛
St. Joseph Ry., L., H. & P., 5% pf.	*k* 75	70	75
Servel, Inc.	6	4⅛*	7⅛*
Sierra Pacific Elec., 2% com.	*k* 35	29*	38⅛*
Sioux City Gas & Elec., 7% pf.	107	99	105⅛
Southeastern Pwr. & Lt., pf.—$7 no par	*l*108⅛	....	....
Southeastern Pwr. & Lt., ptc. pf.	*l* 66⅛	....	....
Southeastern Pwr. & Lt., com.—no par	43	41⅛*	44⅛*
So. Calif. Edison, 8% pf.	29	36⅛	29*
So. Calif. Edison, 7% pf.	*k* 28⅛	28⅛*	28⅛*
So. Calif. Edison, 6% pf.	*k* 26⅛	25⅛*	27⅛*
So. Calif. Edison, 8% com.	45⅛	43⅛*	47⅛*
Southern Cities Utilities, 7% pf.	*k* 76	67	90⅛
Southwestern Lt. & Pwr., A $3.	70	60	65
Southwestern Lt. & Pwr., B.	65	60	65
Southwestern Lt. & Pwr., $6 pf.	92	83	91⅛
Southwestern Pwr. & Lt., 7% pf.	*k*110⅛	110*	111⅛*
Standard Gas & Elec., 8% pf.	67⅛	65*	67⅛*
Standard Gas & Elec., 7% pr. pf.	111	110⅛*	111*
Standard G. & E., com. $3.50	60⅛	57⅛*	65*
Standard Power & Light, com.	36⅛	29⅛*	37⅛*
Standard Pwr. & Lt., 7% pf.	*k*104	103⅛*	105*
Staten Island Edison, pf.—$6—no par	102⅛	99	103
Superheater, $6 com.—no par	170	164*	178*
Syracuse Lighting, 7% pf.	*k*110	103	111
Syracuse Lighting, 8% pf.	*k*117⅛	114	119
TAMPA ELEC., com. $2	*k* 62	62*	64*
Tenn. Elec. Pwr., 6% pf.	103⅛	92	103
Tenn. Elec. Pwr., 7% pf.	110	103	110
Terre Haute, Ind. & East. Trac., 5% pf.	*k* 10	20	30
Terre Haute, Ind. & East. Trac., com.	*k* 1	1	3
Tex. Pwr. & Lt., 7% pf.	*l*113⅛	113⅛*	115*
Tide Water Pwr., 8% pf.	111⅛	105	111
Timken Roller Bear., com.—$4 no par	116	113⅛*	134*
Toledo Edison, 7% pf.	*l*109	102*	107*
Toledo Edison, 6% pf.	*k*103	95	105
Toledo Edison, 6% com.	*k*100	93	102
Tri-City Ry. & Lt., 6% pf.	*k*100	96	99
UNITED GAS & ELEC., 6% pf.	98	98	103
United Gas & Elec. (N. J.), 5% pf.	75	70	77
United Gas Impr., 8% com.—50	*c*113	111⅛*	117⅛*
United Lt. & Pwr., pf.—$4—no par.	*k* 55	53*	55⅛*
United Lt. & Pwr., pf.—$6.50—no par	*a* 99	95*	100*
United L. & P., com. A .48—no par.	*a* 15⅛	14*	17⅛*
United L. & P., com. B .48—no par.	*m* 18	19*	20*
Utah Pwr. & Lt., 7% pf.	*i* 112	109⅛*	111⅛*
Utica Gas & Elec., 7% pf.	106	105	106⅛
Utica Gas & Elec., 8% com.	*k*200	215	225
Utilities Pwr. & Lt., 7% pf.	100	93	100
Utilities Pwr. & Lt., com. A $2	*s*9	28⅛*	30⅛*
Utilities Pwr. & Lt., com. B $1—no par	20⅛	18⅛*	21*
VERMONT HYDRO-ELEC., 7% pf.	*k* 98	95	100
Virginia Elec. & Pwr., 7% pf.	*k*111	105	110
WAGNER ELEC., 7% pf.	*b* 99	96⅛*	99⅛*
Wagner Elec., com.—no par	*b* 38⅛	37*	40*
Washington Ry. & Elec., 5% com.	*k*480	180	475
Washington Ry. & Elec., 7% pf.	102⅛	....	....
Washington Wtr. Pwr., 8% com.	*k*228	136	182
West Penn Elec., 7% pf.	113	109⅛*	114⅛*
West Penn Elec., Cl. A $7.	*k*110⅛	106⅛*	109⅛*
West Penn Pwr., 7% pf.	114⅛	114⅛*	116⅛*
West Penn Pwr., 6% pf.	110	109⅛*	113*
West Virginia Lt., Ht. & Pwr., 7% pf.	*k* 95	94	100
Western Pwr., 7% pf.	*k*102	98	105
Western States Gas & Elec., 7% pf.	*k*102	96	106
Western States Gas & Elec., com.	38	....	....
Westinghouse Elec. & Mfg., 8% com.—50	92⅛	88⅛*	100⅛*
Weston Elec. Instrument, Cl. A $2—no par	*k* 33	30⅛*	34*
Weston Elec. Instrument, com.—no par	*k* 12⅛	12⅛*	14⅛*
Wheeling Elec., 6% pf.	*k*104	95	104
Worthington Pump, 7% pf. A.	*k* 49	46⅛*	55*
Worthington Pump, 6% B.	*k* 45	41*	49⅛*
Worthington Pump, com.	28	28*	34⅛*
YALE & TOWNE com. $5—25,	*k* 73⅛	72⅛*	75*

Stock Exchange: *a*Chicago; *b*St. Louis; *c*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Francisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, Feb. 18. *l*Bid price Tuesday, Feb. 21. *m*Latest quotations available. †Dividend rate variable. *1928

Utility Offerings Total $32,000,000

New offerings by electric light and power companies during the week ended Feb. 23 amount to $31,637,500, three companies contributing to this total. The largest individual issue was offered by the National Public Service Corporation in the form of secured gold debentures, priced at 93½ and accrued interest to yield over 5.35 per cent, a piece of financing involving a sum of $20,000,000. These securities, dated Feb. 1, 1928, mature Feb. 1, 1978. Proceeds from their sale will be used for retiring the company's thirty-year 6½ per cent sinking fund collateral trust gold bonds now outstanding and for other corporate purposes. These secured gold debentures will be a direct obligation of the National Public Service Corporation.

The American Superpower Corporation, which has drawn up a plan for the revision of its capital structure, as announced elsewhere under "Financial and Statistical News," issued 90,000 shares of first preferred stock at $102.50 per share and accrued dividends, to yield 5.85 per cent. Proceeds will be used for the acquisition of additional interests in certain electric light and power companies and for other corporate purposes. This stock is cumulative as to dividends at the rate of $6 per share per annum.

With the purpose of refunding short-term loans outstanding the New England Public Service Company issued 25,000 shares of $6 dividend series preferred stock, the price being $96.50 per share and accrued dividends to yield over 6.20 per cent. Cumulative dividends are payable quarterly.

California Edison Seeks Stock Authorization

Southern California Edison Company has made application to the Railroad Commission of the State of California for permission to issue some $6,000,000 of new common stock to be sold to shareholders at par $25 on the basis of one new share for each ten shares of common or original preferred stock held. The $6,000,000 stock issue is approximately 20 per cent of the estimated budget for construction and expansion for 1928. R. H. Ballard, vice-president, has announced that financing part of the budget each year through issue of rights to common stock holders will be a permanent feature. Hitherto it has been the practice of the company to give shareholders rights, but these were issued at no stated periods.

Business News and Market Conditions

Code to Recognize "Thin Wall Conduit"

Mass of Detailed Agenda Prevented Final Action—Correlating Committee Appointed and Electrical Committee to Meet Again in Time to Offer 1928 Code in Fall

HARMONIOUS action toward the recognition of electrical metallic tubing, known to the trade as "thin wall conduit," in the code took place at the meeting of the electrical committee of the National Fire Protection Association last week. The report of the article 5 committee on thin wall conduit was presented by A. Penn Denton and a minority report was submitted by W. H. Blood. With the concurrence of Mr. Blood and Mr. Denton both reports were ignored and the committee discussed each principle separately. Out of the discussion the committee evolved eight points as given elsewhere on this page.

Owing to the heavy agenda covering a mass of detail the electrical committee was unable to discuss anything but the principles of the reports submitted. The usual attention was given to articles 1, 2, 3, 4, 6, 7, 8, 9 and 10. In order to have a 1928 code a motion was made by L. P. Dendel as follows:

Because the field of National Electrical Code users, code administrators and other interests, including manufacturers, were promised by this electrical committee at our 1927 meeting that at the 1928 meeting of this committee a code would be produced taking into account the evident field needs, and, because of the absolute need that the code be correlated and be consistent and overlook no serious needs by mere failure to give them proper attention or by reason of no means provided prior to this meeting for correlation of article committee reports and, because our responsibility as code makers is seriously challenged if we cannot get out the necessary code revisions promptly to care for field needs and, because the National Electrical Code is expected by the field to give this needed guidance in the interest of economy and safety;

It is therefore moved that a correlating committee be chosen at this time, subject to later additions to its personnel. That there be not less than seven members, one of whom shall be the chairman of the editorial committee. That any article committee chairman who desires may be a member. That there be a majority of inspector members, who shall be understood to be acting, not as individuals, but for and under advice of their constituent inspector associations and that all recognized industry associations be so represented. That the chairman of the correlating committee be selected by the main committee.

The correlating committee is hereby instructed to co-operate with article committees to whom reports have been referred back for revisions so that such article committee work is completed within the next sixty days from today (Feb. 17, 1928), and so that the correlating committee may bring in a report by May 1, 1928. This correlating committee report to be distributed immediately to all members of this electrical committee, in order that this committee may meet and take formal action on a new 1928 code not later than July 1, 1928, thus making the complete new code available to the field by the early fall of 1928.

Article 5 to Be Divided

The correlating committee was instructed to use generally the text of the 1925 code and to incorporate only what seemed to be necessary new ideas. A motion was passed instructing the editor of the code to divide article 5 into two, three or more chapters because its present size imposed too much of a burden on any one committee. The report of the committee on article 8 to have a new 0-15-amp. fuse cutout in which higher rating fuses could not be used was indorsed by the committee and the Underwriters Laboratories was instructed to work out a standard for such a fuse and report on it next year.

Demand Factor for Feeders Adopted

The recommendation for a diversity factor, termed by the committee a demand factor, on mains and feeders was adopted in principle with some few changes in text covering principally its application to service conductors and modifications with respect to heating appliance loads. The method of estimating the demand factor will be provided in the code and depends on the diversity of load on the feed such that the maximum demand is less than the total connected load.

No action was taken on the grounding of portable appliances but A. R. Small was instructed to call a general meeting of all interested and to report the result to the committee. The electrical committee did not support the minority report of Mr. Blood regarding the use of the circuit wire for grounding in the case of non-metallic sheathed cable. The committee passed in principle rules regarding gas tube signs and X-ray apparatus which for the first time will appear in the code. The article 16 committee sponsored a table which will provide for special circuits in laundries, kitchens and bath rooms of residencies and provides for a 25-amp. circuit for plugging in 2,000-watt heaters. The correlating committee will develop specific rules to cover such special 25-amp. circuits and will present them at the proposed electrical committee meeting later in the year.

A resolution was presented by W. H. Blood at the end of the meeting calling for the appointment of a special committee to study the entire code making system and report upon six specific items and report to the electrical committee at the next annual meeting. The resolution presented by Mr. Blood is as follows:

Whereas it is desirable that the National Electrical Code should continue to have the respect and confidence of the electrical industry, and at all times should be recognized as an American standard for universal acceptance, and,

Whereas the present procedure in the revision of rules and especially in the consideration and adoption of new electrical devices and systems is slow, tortuous, productive of undesirable expense and tends toward commercial strife, and,

Whereas for the benefit of the entire electrical industry and for the public at large these conditions should be corrected; therefore be it

Resolved: That the chairman of the electrical committee appoint a special com-

Rules for Electrical Metallic Tubing

Points set up by the electrical committee of the N.F.P.A. in regard to electrical metallic tubing known to the trade as "thin wall conduit."

1. To extend recognition to electrical metallic tubing of circular cross section.

2. To specify that when installed it will be readily identifiable as compared to standard conduit. The electrical committee has left it to the Underwriters Laboratories to specify the distinguishing features necessary for electrical metallic tubing.

3. That electrical metallic tubing shall have the same nominal inside diameter as standard conduit.

4. That only threadless fittings of approved design shall be used.

5. That trade sizes shall be ⅜ in. for under-plaster extensions only and ½ in., ¾ in., and 1 in.

6. Its use shall be limited to circuits using not larger than No 8 wire and carrying not over 35 amp. at voltages not exceeding 300 between conductors or 150 to ground.

7. To be installed as a complete system without wires continuous from fitting to fitting and the entire system firmly secured in place. It is not to be used in places where during installation and afterwards it may be subjected to severe mechanical injury. It shall not be imbedded in masonry, concrete or fill in buildings during their course of construction.

8. If of non-corrodible material it shall have a wall thickness and physical properties equivalent to the electrical metallic tubing being considered.

mittee to be known as the "committee on procedure" and that this committee consist of seven (7) members, the chairman of the electrical committee to be one and ex officio chairman of the committee on procedure and further that the committee consider and report upon the following matters:

1. The present membership of the electrical committee as to whether the proper organizations are represented best to secure an electrical code which may continue to be respected as national in principles and scope.

2. The size of the committee and members of representatives to which the various organizations should be entitled and whether other than representatives of national organizations should be included.

3. Methods for best considering changes in the code and additions to the code on their merits, regardless of other considerations.

4. The advisability of restricting voting privileges of those who are bound by commercial considerations.

5. Methods for improving present procedure which will simplify it and facilitate the adoption of new electrical devices and systems, retaining necessary safeguards, but making it possible for inventive genius promptly to be acknowledged and the public to be given the advantage of progress in the art without unnecessary delays.

6. The best and most practicable methods of co-ordinating the code, now and in the future, in order to make it a set of intelligent rules devoid of verbosity and textbook phraseology.

7. That a report of this committee be made at the next annual meeting of the electrical committee.

1927 Rate of Production Maintained

January Activity in Electrical Manufacturing Plants on Level With January, 1927—Normal Trend Indicated for Next Few Months

THAT the electrical manufacturing plants of the nation are operating at approximately the same level as that reported at this time last year is indicated by reports received by ELECTRICAL WORLD on the monthly electrical energy consumption by a large portion of these plants. The rate of production of electrical equipment and supplies during January was about 0.6 per cent under December and 4.4 per cent under November, but was at exactly the same level as reported for January, 1927. A study of the operations in past years indicates that these monthly decreases in activity since October are normal, and that similar monthly decreases in the rate of activity may be expected in the industry until May or June, when the low point of monthly operations should be reached.

The index of activity in the electrical manufacturing industry, based upon consumption of electrical energy, stands at 124.7 for January, as compared with 125.4 for December and 124.8 for January, 1927. Comparative indexes of productive activity referred to the average activity for the period of 1923-25 as 100 and adjusted for number of working days are as follows:

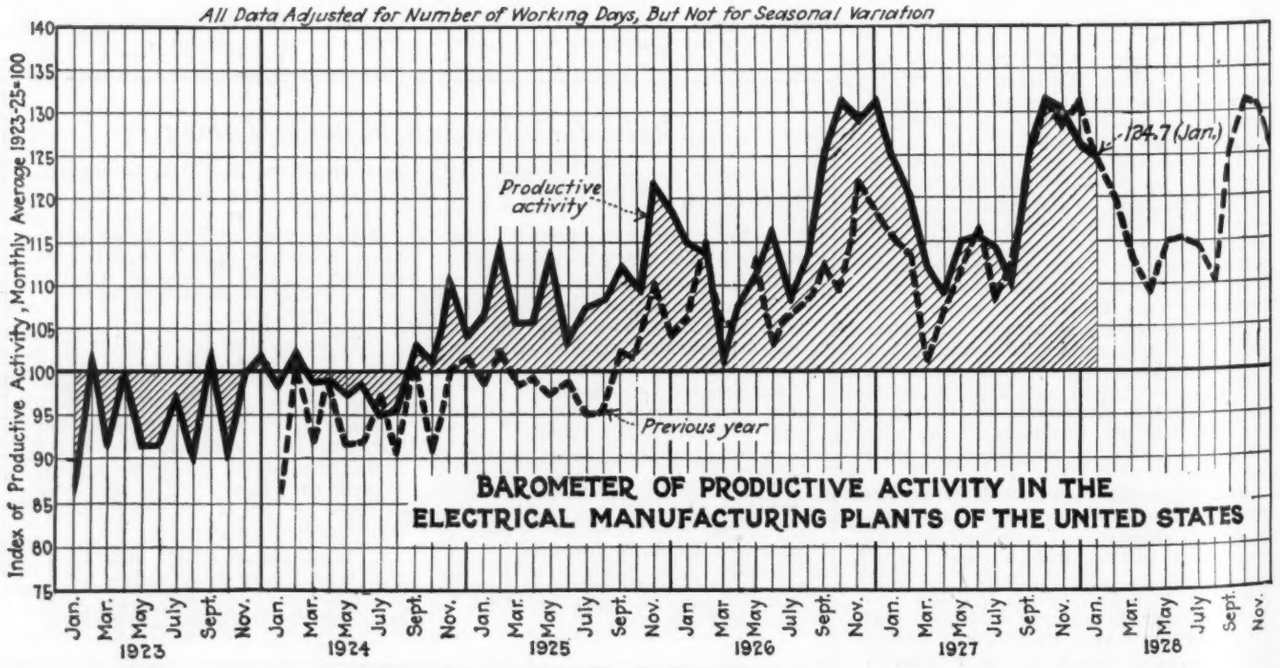
January, 1928	124.7
December, 1927 (revised)	125.4
November, 1927	130.4
January, 1927	124.8
January, 1926	115.0
Average for full year, 1927	119.5
Average for full year, 1926	116.6

Operations of American industry in general during January were about 9.2 per cent over those reported for December, an increase in the rate of operations being reported by all of the outstanding industrial groups except food, lumber and paper. An upward trend of considerable proportions is to be expected at this season of the year, but the fact that the impulse is felt by a very large proportion of the industrial groups instead of being confined to a few groups is a significant fact, offering an excellent basis for prognosticating a continuance of our present industrial prosperity, at least through the first half of 1928.

Application of Industrial Trucks in Industry

A handbook entitled "Profitable Application of Electric Industrial Trucks and Tractors in Industry" has been published by the Society for Electrical Development as a co-operative measure of twenty manufacturers of electric industrial trucks and tractors, storage batteries and accessories who are engaged in a market development program. The book is of interest to plant managers, department heads, efficiency experts, or any who have to do directly or indirectly with material handling in and about the warehouse and industrial plant. The handbook contains 96 pages and 136 illustrations.

With a special chapter for each of sixteen major industries the book is based on a survey of 200 typical plan operations made by a member of the survey committee of the American Society of Mechanical Engineers. For each of the industries, the operating processes and the particular type of truck suited to individual jobs are described. An outline of operating costs, together with a tabulation of direct savings effected by employing this means of equipment, is given.



Market Conditions

ENCOURAGING activity in the sale of central-station supplies is noted in the New England district. Railroad companies are planning increased purchases, small motor sales are a little below the normal trend, but are steady, and negotiations for heavy equipment have fallen off. In the Eastern district manufacturers are encouraged with current business and report that inquiries are maturing in better volume. A manufacturer of substation equipment states that his plant is running on a capacity schedule for current deliveries, and a company making water turbines reports that business is improving, with a decided increase in February as compared to January.

In the Southeast an order was placed by a central-station company in Alabama for $90,000 worth of power transformers. Purchases by industrial plants are slow but inquiries are good. Improvement in sales is noted in the St. Louis district. A power company in the southwestern part of the district purchased a fair amount of distribution equipment, and several good orders for line construction materials have been shipped. Utility companies are active in the Middle West and are preparing for large line extensions in the spring. On the Pacific Coast an order placed by the Michigan-California Lumber Company of Camino covered about $42,000 worth of equipment. Oil field activity was another feature of the week's business.

Central-Station Supplies Active in New England

Encouraging activity is reported in the sales of central-station supplies with the demand for new service lines and expansions quite marked. Orders for pole-line supplies included a good volume of wire and hardware and poles. One order for four cars of line materials is noted; another group of orders called for five car loads of cross arms, hardware and wire. Railroad companies are planning for greater purchases than during the past year and to date sales show an encouraging increase. Weatherproof wire sales are active, switch and control equipment demand is steady, and a temporary slackening of outside work has slowed up contractors' needs.

Small motor sales are a little below the normal trend but are steady and reached over $35,000 last week. Negotiations for heavy equipment have fallen off, and transformer inquiries are quiet. An order for two 20-kw. baking ovens was reported. Industrial lighting projects are being considered in good volume with school-house plans numerous. The Malden Electric Company plans to erect a new service station at a cost of about $100,000. New building contracts placed last week show a marked increase over previous years. The Brockton Ice & Coal Company, Brockton, Mass., has filed plans for an ice plant to cost $100,000.

Utility Companies Active in Middle West

A slight slowing up or reactive tendency was noticeable in the Middle West in some lines, while in others expansion is going on steadily. Considerable activity in the steel, automobile and railroad industries is evident and industrial plant buying generally is good. The various utility companies are busy preparing for large line extensions in the spring. Considerable purchasing of apparatus is under way and several interesting orders were placed, including auxiliary motor switchboard equipment complete with appurtenances, settings for one reheat and two standard B. & W. boilers, two oil circuit breaker units, steel inclosed outdoor type isolated phase 15-kv. switches, four heater drain pumps and appurtenances arranged for motor drive, structural steel and iron valued at $50,000 and Mazda lamps valued at $160,000. Maintenance purchasing is quite high with a good demand for poles and pole line hardware. Jobbers' sales are normal. The acceptance of the new gyrator type washing machine by the public has had a stimulating effect on washing machine sales, one jobber placing a single order for 1,000 machines.

Construction projects are as follows: Springfield, Ill., plans a substation to cost $60,000. The Interstate Power Company has authorized surveys for a hydro-electric plant near Decorah, Iowa. The Houghton County Electric Company plans power plant expansion at Houghton, Mich., and extensions in transmission lines to L'Anse and Baraga, Mich. Detroit Lakes, Minn., will receive bids March 5, for a 500-kva. generating unit (and alternate bids for a 625-kva. unit) with auxiliary equipment, including motor-driven ash hoist, for the municipal power plant. The Northwestern Utilities Corporation has purchased the Mapleton Electric Company, Mapleton, Minn. The Nebraska Power Company will rebuild its power line from Millard to Chalco, Neb., for operation at increased voltage. Cedar Falls, Iowa, plans a transmission line to points in Mount Vernon Township. The Iowa Public Service Company plans the purchase of the municipal lighting plant at Jolley, Iowa. Arlington, Neb., has secured permission to build a transmission line for commercial service. The Elkhorn Valley Power Company plans a transmission line from Clarkson to Creston, Neb.

Non-Ferrous Metal Markets Dull—Prices Stable

Little activity prevails in the copper market and prices quoted by large producers are steady, although some interests are willing to sell for several points less. The lead market is dull, consumers evidently feeling that prices are uncertain and that plenty of lead is available. Orders are mainly for prompt shipment. The zinc market has declined slightly. Tin, after the largest price decline in several years, appears stable.

NEW YORK METAL MARKET PRICES

	Feb. 15, 1928 Cents per Pound	Feb. 21, 1928 Cents per Pound
Copper, electrolytic	14-14¼	14
Lead, Am. S. & R. price	6.35	6¼
Antimony	11	10¾
Nickel, ingot	35	35
Zinc spots	5.92½	5.80
Tin, Straits	51¼	51.725
Aluminum, 99 per cent	24.30	24.30

Base copper wire price Feb. 21, 1928, 15¼ cents.

Large Transformer Order Placed in Alabama

Purchases by industrial plants in the Southeast are slow, though inquiries are good, and activities in the central-station field are improving slightly. A central-station company in Alabama ordered power transformers totaling $90,000 and a South Carolina power company ordered similar equipment to the extent of $13,500. House-type meters are in brisk demand, the majority of individual orders averaging $1,500, though two orders received from Tennessee aggregated $8,000 and one from Georgia amounted to $2,500. In connection with the change of its direct-current system to alternating current, one company ordered $6,800 worth of elevator equipment in the past few days. Another interesting central-station order called for switching equipment amounting to $7,900. Two turbine inquiries are in hand, one for an industrial plant and the other for a small utility company.

One manufacturer reports the receipt of an order from Alabama for a mine locomotive costing approximately $9,000, and two industrial motor orders from the same state, one amounting to $6,000 and the other, $3,500. There is considerable activity in connection with prospective textile mills to be located in this territory and although definite announcements are not immediately forthcoming all or a large portion of this should materialize within a reasonable period.

Construction projects reported are as follows: The E-Z Opener Bag Company, Decatur, Ill., plans a paper mill at Tuscaloosa, Ala., to cost $3,000,000. The Columbus Electric & Power Company, Columbus, Ga., is having plans drawn by Stone & Webster, Inc., Boston, for a hydro-electric plant on the Chattahoochee River, to cost $7,000,000. The Columbus company also will build

a substation near Cusseta Highway, to cost $50,000. The Carolina Gas & Electric Company has acquired the municipal lighting plant at Kinston, N. C. The Carolina Power & Light Company plans a substation at Sanford, N. C., to cost $70,000. The Savannah River Electric Company plans a hydro-electric development on the Savannah River, near Greenwood, S. C., to cost $20,000,000. The South Carolina Power Company plans the purchase of the municipal electric plant at Walterboro, S. C. The Peter Fox Sons Company, Chicago, plans an ice and cold storage plant at Nashville, Tenn., to cost $350,000. The East Coast Utilities Corporation, Richmond, Va., plans a power plant at Port Richmond, to cost $40,000. Milledgeville, Ga., has contracted with the Georgia Power Company for an ornamental lighting system, and Louisville, Ky., also is planning an ornamental lighting system in its parks.

Utility Orders Encourage Eastern District

Manufacturers in the Eastern district are encouraged with current business and the improved immediate outlook for additional commitments. Inquiries are maturing in better volume. A central-station company in the New York territory has placed a fair-sized order for special switching equipment for substation service, and further business is anticipated from that quarter. Another power company has contracted for switching apparatus of the 6,600-volt type, both for indoor and outdoor service. A large manufacturer of substation equipment of this character reports a growing volume of business from a number of sources, with its plant running on a capacity schedule for current deliveries. High-voltage insulation apparatus is beginning to move at a better pace and several important orders have been placed in the New York market. A manufacturer of water turbines states that business is improving, with a decided increase this month as compared with January. A public utility in Vermont has contracted for a sizable unit, while a paper mill at Lee, Mass., also placed an order for a prime mover.

Industrial business holds rather uniform. Motor sales continue fair, with popular industrial sizes in demand from several branches of trade, including ice cream factories, metal-working shops, paper mills, leather plants and textile mills. Fractional-horsepower motor sales are active, and a leading manufacturer has secured an order for 160 1/20-hp. motors for a company in Brooklyn, to be used for electric office appliances. Electric fan business is showing fair promise for early spring.

Immediate construction activities include the following: Steel & Tubes, Inc., Brooklyn, plans a steel strip mill at its Elyria, Ohio, plant, to cost $1,000,000; Perth Amboy, N. J., plans an ornamental lighting system on Maple Street. The Public Service Electric & Gas Company will build a substation at Ridgewood, N. J. The John A. Roebling's Sons Company, Trenton, N. J., will build an addition to its wire and cable plant to cost $500,000. The Philadelphia Suburban-Counties Gas & Electric Company plans an addition to its plant on Barbadoes Island, Schuylkill River, near Norristown, Pa., and extensions in transmission lines. The Viscose Company plans an addition to its rayon mill at Lewistown, Pa., to cost $400,000. The Pennsylvania-Ohio Power & Light Company has secured permission from the United States Engineer, Pittsburgh, for a transmission line across the Ohio River, near Girard, Ohio. The White Company, Baltimore, Md., will build an addition to its paint factory to cost $100,000. C. Hoffberger & Company, Baltimore, will take bids at once, to be received about March 10, for an eleven-story cold storage and ice plant to cost $900,000. The Chief of Engineers, United States Army, Washington, D. C., will soon take bids for a 1,200-kw. Diesel engine-generating set, with auxiliaries and one station switchboard. The United States Engineer, Pittsburgh, Pa., will receive bids until March 9 for two hydraulic turbines (Circular 274).

Improvement in Sales Noted in St. Louis District

A slight improvement in business is noted in the St. Louis district. Not many large contracts have been closed but several are being figured. One order was placed for a 150-kw. generator and a switchboard for $4,300. A lot of feeder voltage regulators, transformers and oil circuit breakers were bought by a power company in the southwestern part of the district at a total cost of $55,000. Several good orders for line construction materials have been shipped out and two contracts closed for conduit, wire and fittings for large office buildings.

Construction projects in the district are as follows: Sterling, Kan., will extend its municipal power plant. The Shreveport Producing & Refining Corporation, Shreveport, La., will enlarge its oil refinery at a cost of $250,000. The Liberty Textile Mills, Liberty, Mo., plans a new cotton mill to cost $100,000. The Board of Public Service, St. Louis, will receive bids March 13 for a complete street-lighting system in district A. The Southern Ice & Utilities Company plans an ice plant at Odessa, Tex., to cost $75,000. The West Texas Utilities Company plans a power and ice plant at Sonora, Tex., to cost $75,000. The Texas Gulf Power Company plans an 8,000-hp. power plant at Texas City, Tex., to cost $200,000. The Southwestern Gas & Electric Company plans a transmission line to Hatfield and Cove, Ark., and vicinity. The Arkansas Power & Light Company plans rebuilding its 66,000-volt transmission line from Pine Bluff to Camden, Ark., to operate at 110,000 volts, at a cost of $185,000. Independence, Kan.; Poplar Bluff, Mo.; El Reno, Bristow and Muskogee, Okla., and Ozona, and Sweetwater, Tex., plan the installation of lighting systems.

Lumber Company Order Placed on Pacific Coast

The outstanding order on the Pacific Coast covered a power installation for the Michigan-California Lumber Company of Camino, consisting of assorted General Electric motors from 2½ to 225 hp., totaling $20,000 with accessories, a 750-kva. Allis-Chalmers turbine, valued at $18,000, and Westinghouse switchboard and control valued at $4,000. Oil field activity was another feature of the week's business. One manufacturer reports five different orders, totaling $20,000, from three companies and comprising six double-rated well motors, one arc-welding equipment and a large automatic panel. The city of Los Angeles purchased $63,092 worth of weather-proof wire and the Southern Pacific Railroad three carloads of iron wire. The latter company is in the market for approximately $20,000 worth of lead cable for its new Fresno classification yard and also plans to build a new tourist hotel near Phoenix, Ariz.

Other new construction projects reported include a $1,000,000 convent and school for Belmont, Calif., and a $2,500,000 apartment house and hotel for Pasadena. New street lighting prospects include Berkeley and Willows. Machinery orders include an order for 200 1/20-hp. motors for calculating machines, valued at $2,500; two circuit breakers at $4,000 for the Alameda substation; one special quadruple motor equipment for $6,000 for an Oakland traction company, and a miscellaneous assortment for the Truckee Carson irrigation project comprising 220 distribution transformers, 250 watt-hour meters, 1,000 line insulators, 1,200 strain insulators and six lightning arrester units having a total value of $35,000.

Construction projects are as follows: The Southern California Edison Company plans a substation at Yorba Linda, to cost $150,000. The United Verde Copper Company, Clarksdale, Ariz., will build an electric steel foundry to cost $100,000. The Snow Mountain Water & Power Corporation, San Francisco, has applied for permission to build a 21,680-hp. hydro-electric plant on the South Eel River, Lake County, to cost $3,200,000. The Coast Counties Gas & Electric Company, Santa Cruz, Calif., plans a substation at Watsonville to cost $35,000. The Red River Lumber Company, Westwood, Calif., plans a hydro-electric plant on Ash Creek, a tributary of Pitt River, Modoc County, to cost $250,000. The St. Helens Pulp & Paper Company, St. Helens, Ore., plans an addition to cost $100,000. The Columbia Valley Lumber Company, Bellingham, Wash., plans a new mill to cost $100,000. The Northwest Power & Light Company has applied for permission to build a hydro-electric plant in Rica Canyon, near Port Angeles, Wash., to cost $2,000,000. Nogales, Ariz., and Compton, Los Angeles, and Pittsburg, Calif., plan street lighting systems.

Activities of the Trade

Allis-Chalmers Announces Changes in Pittsburgh Works

Effective March 1, 1928, the Pittsburgh Transformer Company, purchased by the Allis-Chalmers Manufacturing Company last year, is to be taken over and operated as the Pittsburgh Transformer works of the Allis-Chalmers company. The manufacture of the Pittsburgh types of distribution and power transformers will be continued at the Pittsburgh works in sizes up to and including 5,000 kva. single phase, and 15,000 kva. three phase at 44,000 volts; up to and including 4,000 kva. single phase, and 12,000 kva. three phase at 66,000 volts, and also all transformers for electric furnace work. The larger sizes of transformers and those for higher voltages and all transformers regardless of size or voltage, equipped with built-in tap changers to operate under load, will be of the Allis-Chalmers type and will be built at the West Allis works.

The Allis-Chalmers company in its announcement says that it appreciates the business given the Pittsburgh Transformer Company during the past years and earnestly solicits continued patronage. The district offices of the Pittsburgh Transformer Company have been consolidated with and will be operated as a part of the Allis-Chalmers district office organization with offices in all principal cities. With a larger organization, increased facilities and advanced manufacturing methods, as well as its extended service organization, the Allis-Chalmers company states that it is in excellent position to serve the industry in its transformer requirements.

THE HYNES & COX ELECTRIC CORPORATION, 406 North Pearl Street, Albany, manufacturer of "Red Crown" electric water heaters, has published a manual on electric water heating for salesmen. The manual has been compiled to enable salesmen to answer quickly and intelligently many of the questions which will be asked by prospects.

THE SERVEL SALES, INC., 51 East 42d Street, New York City, announces the appointment of John M. Bickel as manager of advertising and sales promotion. Mr. Bickel comes from the Magazine Repeating Razor Company, where he has been assistant general sales manager.

THE PACIFIC ELECTRIC MANUFACTURING COMPANY, 5815 Third Street, San Francisco, has opened offices in Seattle, Wash., at 516 Liggett Building, with Charles H. Cutter in charge.

THE BELDEN MANUFACTURING COMPANY, 2300 S. Western Avenue, Chicago, manufacturer of insulated wires and cables, has added to its cord department a new soft rubber plug for household appliances, office and store equipment, portable shop tools and other devices.

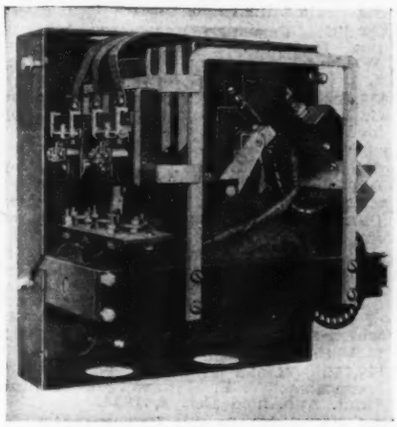
THE CLIFTON MANUFACTURING COMPANY, Boston, manufacturer of rubberized fabrics, announces that E. W. Kendall has been appointed manager of its electrical tape department in charge of all domestic and export tape sales effective March 1. For the last five years Mr. Kendall has been in the sales department of the Westinghouse Electric & Manufacturing Company. The Clifton company states that it will continue its constructive distribution policies through electrical jobbers.

THE LINCOLN ELECTRIC COMPANY, Cleveland, manufacturer of "Linc-Weld" motors and "Stable-Arc" welders, announces the appointment of O. D. Fries as salesman in charge of consumer motor business in Detroit under the direction of J. M. Robinson, district manager.

New Equipment Available

Automatic Induction Starter

An automatic induction starter with two adjustable features has been announced by the Lincoln Electric Company, Cleveland. One of the adjustments is in the starting current and starting torque and is made by changing the position of the rotor in the regulator. This rotor is index mounted and the starting torque and starting current of the motor are increased by going to the higher numbers of the scale and decreased by going to the lower. The other adjustment is in the current at which the throw-over takes place. The throw-over is controlled by a retarding solenoid which is operated by the motor current. The pull of this solenoid can be adjusted by a simple lock rod arrangement carried on its plunger.



ADJUSTABLE STARTING CURRENT AND STARTING TORQUE ARE PROVIDED BY THIS AUTOMATIC INDUCTION STARTER

The manufacturer states that the starter can be mounted very easily. In mounting, the back cover is first secured to the wall. It is light and can be easily held and attached by one man. The back cover contains the conduit outlets. After the leads are drawn the switch may be set into the back cover and locked in position by a screw provided for that purpose. The conventional start and stop buttons are used in connection with the starter. If the front cover of the starter is removed the switch may be swung forward by the removal of the holding screw at the back. This brings the switch mechanism out where it is in a better position for observation. The barriers may also be moved upward out of the way. By the release of a screw on the control switch panel the contact carrying arm will drop back exposing all contacts for renewals or observation. The barriers completely inclose the contacts and six separate arc chimneys are provided to confine the arcs. The manufacturer states that with this barrier the switch can interrupt currents of ten times the rating without injury. The contacts in the switch are designed to give a wiping action. Overload protection is afforded by thermo-relays and no-voltage protection by no-voltage release control.

METERING PANELBOARDS.—A metering panelboard of the loose-wire type, which the manufacturer claims will handle any metering problems that confront the builder, has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh. Loose-wire connectionus replace the usual copper bus bars, directly lowering the price and speeding up installation. Four main types are being made. This panel is said to be particularly adapted to service in apartments and office buildings where frequent change of tenants makes meter changing an important item.

AUTOMATIC DYNAMOMETER CONTROL PANELS.—A fully automatic control equipment for use with dynamometers in testing internal combustion engines has been placed on the market by the General Electric Company. The new control equipment consists of two panels, one a control panel and one a master panel. This arrangement permits mounting the master panel on the dynamometer base, providing complete control of the dynamometer at the point where the actual testing is being done. The automatic control panel, with its motor-operated rheostats and absorption resistor, is mounted at any suitable, remote place.

Electrical Patents

Announced by U. S. Patent Office

(Issued Jan. 3, 1928)

*1,654,949. CURRENT-REGULATING ARRANGEMENT FOR RECTIFIERS; P. M. Toulon, Paris, France. App. filed Dec. 21, 1923. To permit of regulating and continuously varying the rectified current.

(Issued Jan. 10, 1928)

*1,655,458. GAS-BURNER IGNITER; A. Dolfi, Yorkville, Ohio. App. filed May 4, 1927.

*1,655,689. CALL SELECTOR; L. L. Chauveau, Paris, France. App. filed Aug. 17, 1922. So arranged that the calling device is actuated only when the selector receives the predetermined group of signals for which it is adjusted.

(Issued Feb. 7, 1928)

1,658,254. ELECTROTHERMALLY RESPONSIVE DEVICE; G. R. Radley, Milwaukee, Wis. App. filed Aug. 16, 1920. Susceptible to influence in accordance with both current and voltage variations.

1,658,259. ELECTRIC RIVET HEATER; J. E. Sederholm, St. Paul, Minn. App. filed Dec. 8, 1924.

1,658,266. SUSPENDING DEVICE FOR TROLLEY WIRES; F. A. Tice, Cincinnati, Ohio. App. filed Nov. 3, 1925.

1,658,315. BATTERY; E. B. Wheeler, New York, N. Y. App. filed June 22, 1927. Dry cell battery employing flat electrodes.

1,658,329. PROTECTIVE SYSTEM FOR ELECTRIC CIRCUITS; P. W. Forsberg, Schenectady, N. Y. App. filed Nov. 3, 1925. For preventing the flow of currents of abnormal value in either direction in a circuit adapted to carry current in either direction.

1,658,334. RESISTANCE MATERIAL; T. A. Holmgren, Stockholm, Sweden. App. filed Jan. 14, 1925. Electrically conductive in a cold state and usable at a high temperature. Consisting essentially of an intimate mixture of finely crushed silicon carbide and a refractory cementing medium, burnt until the cement has more or less sintered.

1,658,380. ELECTRICAL SYSTEM; L. S. Keilholtz, Dayton, Ohio. App. filed July 11, 1919. Farm-lighting unit.

1,658,446. BULB ADAPTER FOR SIGNAL LAMPS; L. C. Kuehner, St. Louis, Mo. App. filed June 28, 1926.

1,658,449. FLUID-LEVEL INDICATOR FOR HIGH-PRESSURE VESSELS OR CONTAINERS; S. Loffler, Berlin-Charlottenburg, Germany. App. filed July 10, 1925.

1,658,474. CIGAR LIGHTER; M. T. Blier, Brooklyn, N. Y. App. filed June 8, 1927.

1,658,488. HIGH-FREQUENCY ALTERNATOR; M. Latour, Paris, France. (Granted under the provisions of the Act of March 3, 1921.) App. filed Sept. 1, 1921.

1,658,501. ELECTRIC CONDENSER; P. B. Vallé, New Haven, Conn. App. filed Nov. 14, 1925.

1,658,511. SWITCH; C. Bruynis, The Hague, Netherlands. App. filed Nov. 12, 1925. For switching 220-volt circuits and using a lower voltage for the operation of the switch.

1,658,522. ELECTRICAL PLUG CONNECTOR; A. J. Frogue and J. I. Sloan, Kansas City, Mo. App. filed June 8, 1925. As used in automobile headlights.

1,658,568. METHOD AND APPARATUS FOR MAINTAINING GASEOUS CONDUCTION DISCHARGES; D. McF. Moore, East Orange, N. J. App. filed July 22, 1922.

1,658,577. REGULATOR; C. H. Smoot, Maplewood, N. J. App. filed March 7, 1927. So constructed as to avoid hunting without loss of sensitiveness or power.

1,658,583. ELECTRIC SOCKET; B. D. Wells, Danbury, Conn. App. filed Sept. 10, 1923.

1,658,598, 1,658,599. SOCKET CONSTRUCTION; J. Hohl, Newark, N. J. Apps. filed April 22, 1921 and Nov. 21, 1922.

1,658,610. SAFETY ELECTRIC FUSE IGNITER; N. M. Olevich, St. Clair, Pa. App. filed June 18, 1927.

1,658,615. ELECTRIC OVEN HEATER; H. O. Swoboda, Edgewood, Pa. App. filed Feb. 10, 1926.

1,658,618, 1,658,619, 1,658,620, 1,658,621. LIQUID FLOW SWITCH; W. W. Walker, East Orange, N. J. Apps. filed Aug. 26 and Oct. 1, 1924, May 26, 1925 and March 25, 1927. Mercury type.

1,658,635. ATTACHMENT PLUG; F. P. Gates, West Hartford, Conn. App. filed Dec. 8, 1926.

1,658,644. CONTROL OF DYNAMO-ELECTRIC MACHINES; H. W. Liddiard, Rugby, England. App. filed Sept. 28, 1926. Connected in parallel and adapted to run at related speeds, as by being mechanically coupled together.

1,658,647. ALTERNATING-CURRENT RECTIFIER; L. B. Miller, Lynn, Mass. App. filed April 14, 1927.

1,658,651. ELECTRIC FURNACE; R. B. Prindle, Schenectady, N. Y. App. filed Dec. 29, 1926. Means for sealing a furnace receptacle around an electrical conductor passing through the wall thereof.

1,658,660. SIGNALING SYSTEM; O. C. Traver, Schenectady, N. Y. App. filed March 30, 1927. Wherein two members are related in synchronism in remotely situated transmitting and receiving stations.

1,658,662. ALTERNATING-CURRENT COMMUTATOR-MOTOR REGULATING APPARATUS; W. Welsch, Niederschonhausen, Germany. App. filed Sept. 25, 1926.

1,658,664. VARIABLE-RATIO TRANSFORMER; F. F. Brand, Pittsfield, Mass. App. filed July 6, 1927.

1,658,677. BRUSH FOR DYNAMO-ELECTRIC MACHINES; M. R. Hanna, Erie, Pa. App. filed July 18, 1927. Having a soft tip and a hard portion at approximately the top half.

1,658,692. ELECTRIC HEATER; J. L. Schroyer, Oak Park, Ill. App. filed Dec. 9, 1924.

1,658,695. CIRCUIT-CONTROLLING DEVICE; O. C. Traver, Schenectady, N. Y. App. filed Jan. 12, 1924. For controlling a circuit a plurality of times in succession at predetermined intervals.

1,658,699. PRESSURE-DIFFERENCE MEASURING INSTRUMENT; M. Weiss, Berlin-Friedenau, Germany. App. filed March 6, 1925.

1,658,703. ELECTRIC-CURRENT COLLECTOR; G. W. Bower, Schenectady, N. Y. App. filed Nov. 27, 1925.

1,658,704. PROTECTION OF ELECTRIC SYSTEMS; M. D. Camhy, Berlin, Germany. App. filed March 11, 1926.

1,658,707. SIGNALING DEVICE FOR MOTION-PICTURE MACHINES; A. Costa, Donora, Pa. App. filed Oct. 31, 1923.

1,658,746. LIGHTNING ARRESTER; C. P. Steinmetz, Schenectady, N. Y. App. filed Sept. 27, 1921. Formed of a plurality of discharge gaps arranged in series, each of the gaps being inclosed by a wall which separates the discharge electrodes of the gap.

1,658,752. CABLE TERMINAL FOR STORAGE BATTERIES; W. F. Wilford, Fort Benton, Mont. App. filed Dec. 8, 1926.

1,658,787. COMPRESSION RHEOSTAT; A. M. Levy, New York, N. Y. App. filed June 4, 1919.

1,658,788. ELECTRICAL RESISTANCE APPARATUS; A. M. Levy, New York, N. Y. App. filed Sept. 21, 1920. Of the compression type.

*Omitted from previous listings of patents as they were received from the Patent Office too late to be included in numerical order.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Pilsen, Czechoslovakia (No. 29,634), for advertising signs, household electric appliances, electric flash buttons and lighting appliances.

Purchase is desired in Warsaw, Poland (No. 29,660), of storage batteries.

A sole agency is desired in Florence, Italy (No. 29,633), for apparatus for electrical treatments and electric toilet equipment.

A sole agency is desired in Oslo, Norway (No. 29,662), for storage batteries.

Purchase or agency is desired in Dresden, Germany (No. 29,678), for ice cream cabinets, drink mixers, and restaurant-type toasters.

An agency is desired in Toronto, Canada (No. 29,631), for electrical power equipment.

An agency is desired in Barcelona, Spain (No. 29,668), for storage batteries.

An agency is desired in Strasbourg, France (No. 29,650), for radio sets and parts.

An agency is desired in Tientsin, China (No. 29,711), for electric refrigerating units.

An agency is desired in Rome, Italy (No. 29,632), for X-ray, related ultra-violet apparatus, and appliances for electric treatment.

Purchase is desired in Comayagüela, Honduras (No. 29,709), of Diesel or semi-Diesel crude oil motor and centrifugal pumps.

New Trade Literature

DRUM CONTROLLERS.—Bulletin GEA-887 issued by the General Electric Company, Schenectady, N. Y., describes and illustrates its CR3110 drum controllers for series and compound wound motors used on crane hoists and for similar applications.

COLD MOLDED PRODUCTS — "Come Adventuring" is the title of booklet R-1 issued by the Cutler-Hammer Manufacturing Company, Milwaukee, in which it gives complete information on the C-H cold molded "Thermoplax," what it is, and the uses to which it can be put. It also contains photographic examples showing where small metal inserts, trademarks, depressions and projections have been incorporated in parts of various shapes and sizes at the time of molding.

AIRPORT LIGHTING EQUIPMENT.—The Crouse-Hinds Company, Syracuse, N. Y., is distributing bulletin No. 2108, describing and illustrating its various types of airport lighting equipment including revolving beacons, landing field illuminating units, boundary, obstacle and marker lights, hangar roof lighting and interior illumination units, etc.

BRACKETS and RECEPTACLES.—A pamphlet No. A1127 issued by the Bryant Electric Company, 1421 State Street, Bridgeport, Conn., covers the Bryant "Alabax" line of porcelain brackets and receptacles for all kinds of installations.

LIGHTING EQUIPMENT.—The Edwin F. Guth Company, St. Louis, is distributing its architectural catalog No. 19 describing and illustrating its different types of artistic lighting fixtures. A number of illustrations show the actual application of some of the units described. Several photographs show how Guth fixtures are made.

INDUCTION MOTORS.—Bulletin No. 1143 issued by the Allis-Chalmers Manufacturing Company, Milwaukee, describes and illustrates its normal torque, type ARX, line-start induction motors with sleeve or roller bearings.

CLUTCH.—The L. G. S. spring clutch is described and illustrated in a bulletin issued by the L. G. S. Manufacturing Company, Indianapolis, Ind. The bulletin shows varied installations and suggests many practical applications. The three different types of clutch made, the ratchet type, the manual type and the centrifugal type are each illustrated and described.

THREADLESS FITTINGS.—The Erie Malleable Iron Company, Erie, Pa., is distributing its catalog of "Kondu" threadless fittings for 1928. Many additions to the line are offered in this new catalog. A number of illustrations show the application of "Kondu" fittings to various jobs.

STOKERS.—The Detroit Stoker Company, General Motors Building, Detroit, has issued a bulletin which describes and illustrates the Detroit underfeed stoker. The bulletin covers in detail such points as the design and construction, ash discharge, how low maintenance cost is insured, etc. A number of installations are illustrated and described and a series of drawings show the proper application of the stoker to all styles of settings. The company also is distributing a bulletin covering the Detroit self-contained uni-stoker.

LIGHTING DATA.—The Edison Lamp Works of General Electric Company, Harrison, N. J., is distributing bulletins LD 107B and LD 137B entitled "The Mazda Lamp in Projection Service," and "Lighting the Home." A number of illustrations showing installations are included.